BEEINFORmed N° 3_2016

THE BAYER BEE CARE POSITION

THE BEE SAFETY OF NEONICOTINOID INSECTICIDES

AT A GLANCE:

- Honey bee health is influenced by many different factors.
- Crop protection products have to undergo extensive ecotoxicological testing, including numerous in-depth tests involving bees, some of which were conducted over several years.
- Regarding neonicotinoids, in no study with realistic exposure scenarios and a correct use of the product have harmful effects on honey bee colonies ever been observed.
- Numerous monitoring studies have shown no systematic place or time-related correlation between the use of neonicotinoids and increased honey bee colony mortality.
- The existing, extensive data consistently suggests that neonicotinoids, if used responsibly and in accordance with usage recommendations, do not represent an unacceptable risk to honey bees and other pollinators.

Certain sections of the public and environmental activists in particular believe neonicotinoid insecticides are responsible for an alleged increase in honey bee mortality or colony losses.

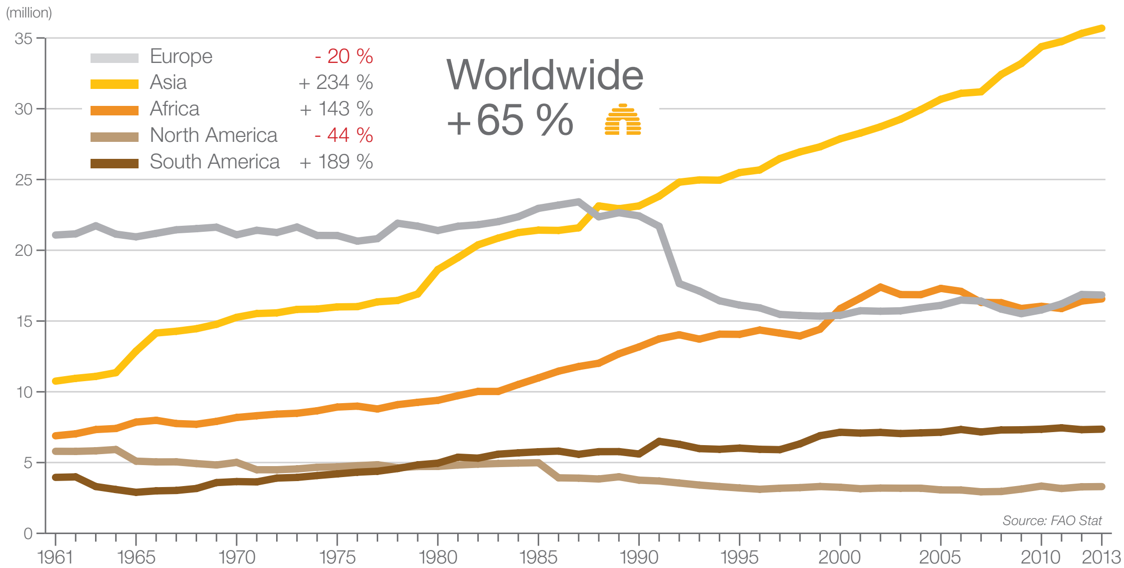
What does scientific evidence have to say about this issue, and what is the Bayer Bee Care position on the bee safety of neonicotinoid insecticides?

Importance of pollinators

Bees and other insects play a significant role in agriculture as pollinators. Although many of the crops providing most of our staple foods (e.g. cereals, maize, rice, potatoes) are not pollinated by insects, the yields of many other crops are dependent, to a certain extent, on pollination by insects or are improved by it (e.g. strawberries, sunflowers, apples). In some cases, insect pollination is a necessary

HONEY BEE COLONIES MANAGED BY BEEKEEPERS WORLDWIDE 1961 – 2013

1961: 49 m hives I 2013: 81 m hives = +65 %



Population dynamics of managed honey bee colonies are primarily determined by socio-economic factors. Population development in Europe and North America has been stable over the last 10 years.

condition for successful cultivation (e.g. almonds, melons or kiwi fruits). Just how important insect pollination is to modern agriculture is indicated by its estimated annual value to the global economy of 235 to 577 billion USD (IPBES Report 2016).

Honey bees *(Apis mellifera)* have a special place among agricultural pollinators because they form large colonies and can be managed with relative ease. Hence, they can be made available in large numbers for pollination services, even in places where no diverse pollinator community naturally exists because of land structures or agricultural practices. Honey bees are thus suitable for pollination in monocultures, for example.

No global decrease of honey bee colonies

In recent decades, managed honey bee populations have greatly increased worldwide, with the FAO recording a 65% increase in honey bee colonies since 1961. Hence, there is no global decline in honey bees. Populations have declined in certain regions (Europe, North America) but have been largely stable again for around the last ten years. In the case of regional declines, correlations have been seen with the number of beekeepers in the respective countries rather than with environmental factors (cf. e.g. Potts et al. 2010).

Though honey bee populations are not declining currently, increased overwintering losses have been observed in some regions. This is due to multiple factors, in particular parasites and diseases. According to data from independent research organizations (European Reference Laboratory for Bee Health, COLOSS), these losses vary greatly from year to year and region to region and no patterns have been discovered that would indicate a causal correlation with agricultural practices, e.g. the use of specific crop protection products.

Importance of chemical crop protection

Chemical crop protection is as crucial to modern agriculture as insect pollination is. Each year, up to 40 percent of global crop yields are lost to plant pests and diseases – without pesticides, these losses could almost double (EU, 2015; OECD/FAO, 2012). The targeted use of crop protection products can prevent losses due to pests, fungal diseases or weeds. At the same time, yields per hectare can be greatly increased. This

Insect pests like these beetle larvae feeding on a potato plant can destroy an entire harvest.

Through their performance, pollinators contribute about 8 % to global crop production (agricultural tonnage).

Each year, up to 40 % of global crop yields are lost to pests and diseases. Without crop protection products, this could almost double.

Source: Oerke et al., 1995 / Yudelman et al., 1998

is particularly important in the context of a growing global population and a limited amount of suitable farmland – land that cannot and, indeed, should not be increased indefinitely.

Since the use of crop protection products to safeguard yields prevents the type of crop failures that repeatedly led to famines in the past (e.g. potato blight in Ireland in the 19th century), it makes a key contribution to food security.

Bayer is committed to sustainable agriculture as the best approach to overcome the global challenges of ensuring secure supplies of quality food. For Bayer, this also entails increasing farmers' profitability, improving people's quality of life, and preserving the environment.

In light of the above facts, it is clear that efficient agriculture needs healthy bees and other pollinators as well as modern crop protection products. The importance of bees and insect pollination to agriculture also makes this an issue of great importance for the crop protection industry. Hence, ensuring and optimizing the balance between bee and plant protection is a highly relevant challenge that is approached in many different ways by the industry.

Challenges to pollinator health

Many pollinating insects, including honey bees, face numerous challenges throughout the modern world. The demand for more food and fodder to feed a growing global population has led to more intensive agriculture, which has contributed to a reduced abundance and diversity of flowers and nesting habitats in agricultural landscapes.

Bad weather, parasites and diseases, inappropriate apicultural practices and exposure to indiscriminately or incorrectly applied chemicals (including pesticides and veterinary products for honey bees) have also been implicated in poor pollinator health.

The debate on neonicotinoids

Despite the proof showing causes of poor bee health are multifactorial, the current public debate on this issue has highlighted crop protection products as a possible factor compromising bee health. There is no doubt that this is due, at least in part, to the generally critical attitude of sections of the public towards pesticides, media reports which focus on the debate and the activities of NGOs with a fundamentally critical stance on the use of chemical crop protection products. It is certainly true to say that the question of how safe insecticides are for bees is a hotbed of public controversy and debate at the moment, with concerns being voiced in many quarters about their possible harmful effects on bees. And neonicotinoids are at the heart of the debate.

The class of substances known as neonicotinoids includes various insecticides, of which imidacloprid, thiamethoxam, clothianidin, dinotefuran, nitenpyram, acetamiprid and thiacloprid are the most widely known. They are used worldwide in a wide range of crops. Like most insecticides, they target the nervous system of insect pests. Their effect is achieved as a result of binding to the nicotinic acetylcholine receptor. The toxicity of neonicotinoids to mammals and humans is very low, which is one of the reasons why they have replaced many older products with a less favorable human safety profile since the 1990s. Neonicotinoids are not all the same and can be divided into two subgroups: the cyano-substituted neonicotinoids (thiacloprid, acetamiprid) and the nitro-substituted neonicotinoids (imidacloprid, thiamethoxam, clothianidin, dinotefuran, nitenpyram). Whereas nitro-substituted neonicotinoids have a relatively high intrinsic toxicity to bees, the toxicity of cyano-substituted neonicotinoids to bees is low (Iwasa et al. 2003). Thiacloprid, for example, has been applied year after year to over millions of hectares of flowering oilseed rape in Germany and other European countries with no harmful effects on exposed honey bee colonies – although it is an important bee forage crop. The low toxicity of cyano-substituted neonicotinoids is due to the bee's natural detoxification system, which is capable of metabolizing the cyano-substituted substances extremely quickly (Iwasa et al. 2003).

One important property of neonicotinoids is their systemicity – their ability to move through the plant. Uptake into the plant provides the plant with protection against pests, especially in the early stages of growth when it is particularly vulnerable to attack by pests and diseases. Once absorbed via the roots, the substances travel in the xylem, the plants water transport system (Sur & Stork 2003) and are distributed within the plant as they are carried upwards and outwards.

Neonicotinoids are therefore ideal for systemic seed and soil treatment.

Horizontal movement within the plant, for which transport within the phloem would also be necessary, is only possible to a very small extent, if at all. This is why movement of neonicotinoids within the plant is also very low after foliar treatment.

Honey bee test under controlled conditions in the laboratory.

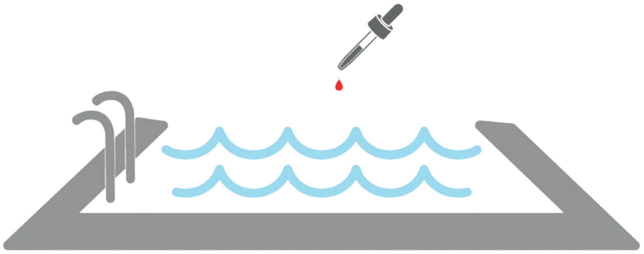
Large-scale Bayer field study to investigate potential effects of neonicotinoid seed-treated oilseed rape to honey bee colonies.

Dose-dependent risk

There is no question that nitro-substituted neonicotinoids are intrinsically toxic to bees. But in order to assess the potential risk they may be posing to bees, it is essential to know the substance dose and concentration levels to which bees are likely to be exposed under practical conditions. After all, the dose an organism is exposed to is a major factor in determining whether or not a substance can have harmful effects under realistic field conditions.

In the case of neonicotinoid seed treatment, bee exposure is very low because the product is applied to the seed and placed in the ground with the seed, ensuring bees hardly come into contact with it. This is why seed treatment is basically a very bee-friendly application method. After the plant has germinated, the substance is partly absorbed by the young plant, which is then protected against damage by insect pests. As the plant grows, the absorbed substance it takes up is increasingly diluted and metabolized, with the substance still in the soil for uptake by the roots decreasing likewise.

As a result, only very tiny traces of the substance can be found in the flowers of seed-treated plants, and in the nectar and pollen in particular, as these are formed at a much later stage in the plants' development.



Scale: 1 – 5 µg/kg corresponds to putting about one drop into an olympic-sized swimming pool of water.

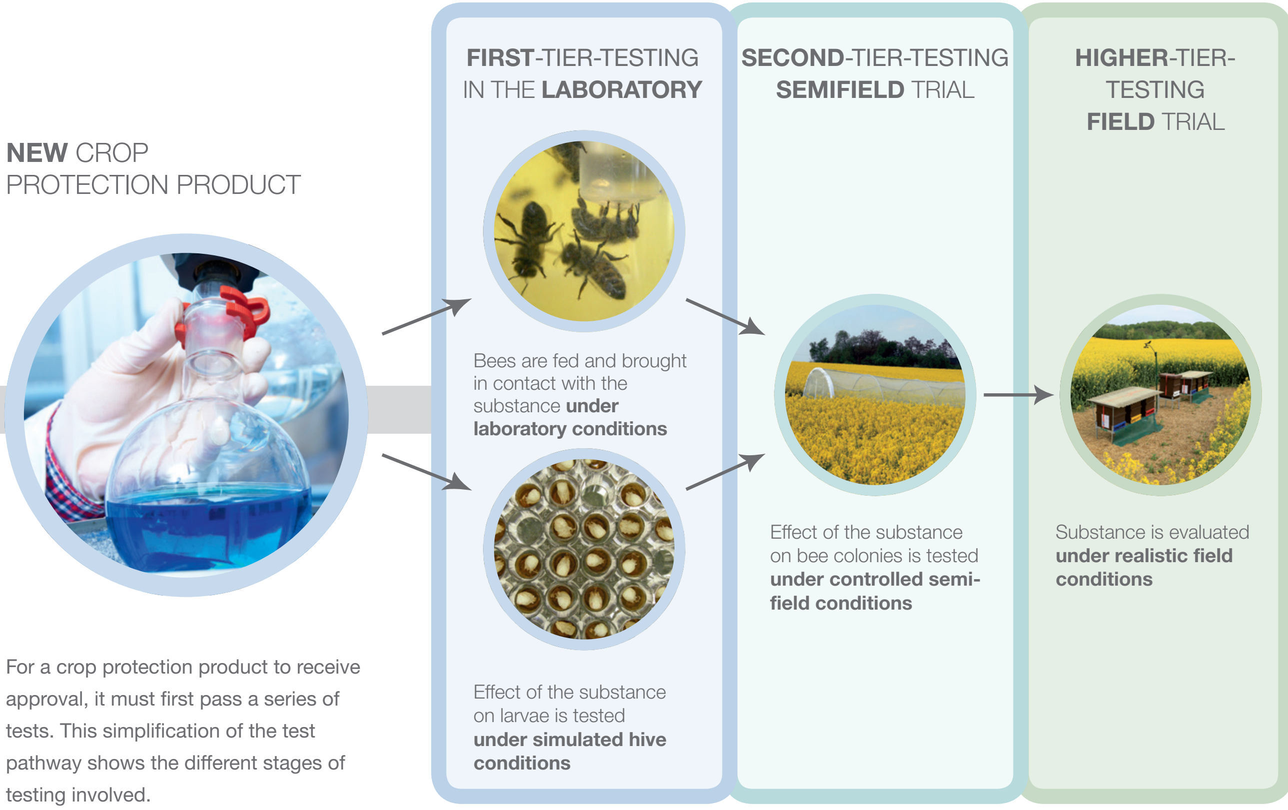
The residue concentration in these structures is typically 1 – 5 µg/kg, and generally does not exceed 20 – 25 µg/kg in plants treated, for example, with imidacloprid or clothianidin (e.g. Maus et al. 2013, Schmuck & Keppler 2003, Schmuck et al. 2005, Blacquière et al. 2012, Pilling et al. 2014), as has been demonstrated through analysis of hundreds of samples in a number of studies conducted in various crops, countries and soil types under varying climatic conditions.

These dietary concentrations have been shown to be safe to honey bee colonies under realistic field conditions, and it can be considered a well-established fact that residue amounts in the nectar and pollen of seed-treated crops are consistently far below the levels that may harm bee colonies under realistic conditions.

Soil residues

Neonicotinoid residues may remain in the soil where seed-treated crops have been grown and can, to a certain extent, be absorbed by subsequent rotational crops. However, since these residues are increasingly bound to the soil matrix over time, they are no longer fully available to other plants. Due to the specific way they break down in the soil, unlimited accumulation in soil is also not possible.

This subject was addressed by a series of residue studies that analyzed the uptake of residues in soil by rotational crops. The studies show that, even at the maximum possible soil residue levels (plateau concentrations), the residue levels in the flowers of subsequent rotational crops are consistently lower than, or at most equal to, those found in directly seed-treated crops (Bayer regulatory submission data, unpublished). In the context of soil residues, extremely high values are occasionally quoted for the degradation time of neonicotinoids in soil (half-lives of 1,000 days and more). These values are taken from studies conducted in Northwestern North America under extreme (cold and dry) climatic conditions that do not occur in Europe's farming regions, where the soil half-life is always considerably shorter than a year.



For a crop protection product to receive approval, it must first pass a series of tests. This simplification of the test pathway shows the different stages of testing involved.

Foliar applications

In the case of foliar applications of nitro-substituted neonicotinoids, specific safety measures to avoid bees' exposure (e.g. restrictions of use in flowering, bee-attractive crops) are specified in the usage recommendations for the relevant products. In this way, a safe use of the respective products is ensured.

Like all crop protection products, neonicotinoids have to undergo extensive ecotoxicological testing before they can be approved as environmentally safe and authorized by the regulatory authorities.

Extensive ecotoxicological testing

Every crop protection product that reaches the market costs on average 286 million USD and requires 11 years of research and development to ensure the highest safety and efficacy standards (Phillips McDougall, 2016). The cost of bringing a new product to market has increased by 55 percent since the turn of the century. Much of the increase in cost is due to a rise in the volume and complexity of environmental safety and toxicology data required by regulatory authorities to ensure products are safe.

In the case of neonicotinoids, much more extensive series of studies have been carried out than was required for registration, and especially with respect to their impact on bees. This ties in with Bayer's strong commitment to the bee safety of its products. The studies conducted include a broad variety of test types from simple laboratory tests to highly complex field trials, some of which analyze the possible effects of the tested products on bee colonies over a period of several years. For imidacloprid seed treatments alone, at least 18 semi-field and more than 15 field trials have been conducted by various testing facilities for a range of crops and in various countries. Similarly, extensive sets of studies exist for clothianidin and thiamethoxam.

Neonicotinoids are subject to extensive studies, e.g. a tunnel test with canola at the Bayer test station Gut Höfchen.

Large-scale field studies

In recent years, various new large-scale field studies on the safety of neonicotinoid seed treatments under realistic agricultural conditions at landscape level have been initiated by the industry in several European countries. One particularly extensive study was conducted in Northern Germany. The results are soon to be published in a scientific journal. In this way, and through the ongoing publication of older data, Bayer is ensuring that the data generated are handled transparently and are accessible to both the scientific community and the public.

No harmful effects

The above studies have covered all the relevant endpoints, be it related to acute or chronic effects, bee brood or bee behavior, mortality, foraging activity, breeding activity, larval and pupal development, nectar and pollen storage, colony health and strength, sublethal effects and much more.

One of the findings of the studies was that, under realistic field conditions, dietary imidacloprid or clothianidin concentrations of at least 20 – 25 µg/kg did no harm to exposed bee colonies.

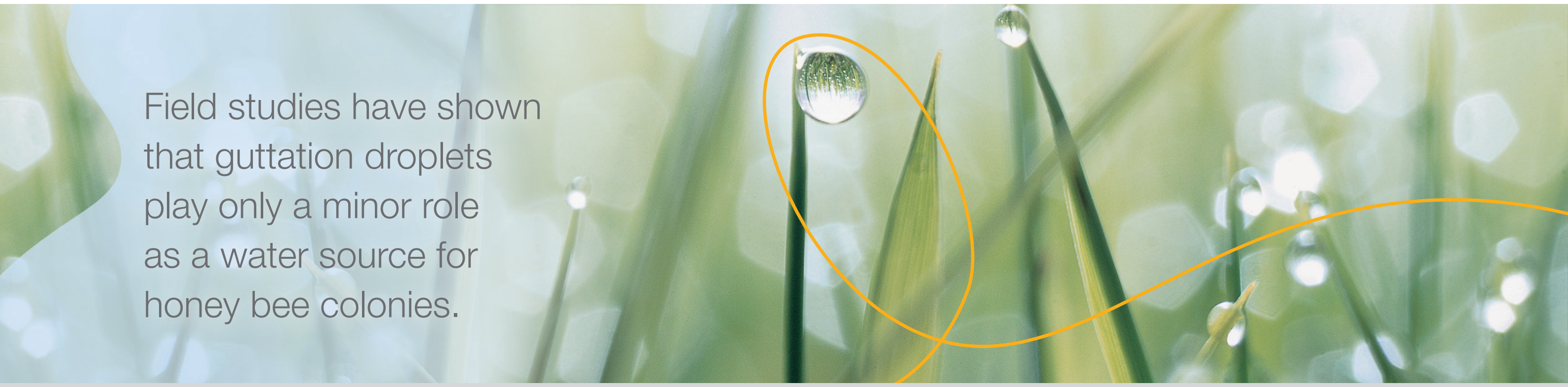
Another finding was that bee colonies exposed to crops grown from neonicotinoid-treated seed are not harmed under realistic conditions, not even by long-term exposure. All these tests were submitted to the competent environmental safety authorities for critical review and form the basis of the authorizations granted for the evaluated products.

In the past few years, academic researchers have published numerous studies on the topic of bees and neonicotinoids. Many of the studies that claim to have discovered adverse effects of neonicotinoids on bees were conducted in laboratories or used otherwise unrealistic exposure conditions. Frequently, exposure doses or concentrations of the tested substances were exaggerated and represented to levels that would never occur under realistic field conditions. So it is not surprising that under such conditions, insecticides affect insects like bees.

However, this does not indicate what the effect of a product might be in the realistic scenarios prevailing in a field under practical agricultural conditions. In cases where a realistic field exposure scenario was tested, the Bayer Bee Care Center knows of no study that has revealed adverse effects on honey bee colonies of a neonicotinoid applied according to best practice and in compliance with the respective label recommendations.

Sublethal damage?

In recent years, various concerns have been expressed that neonicotinoids might harm honey bees sublethally, i.e. not killing them but affecting key parameters such as homing ability, foraging behavior, etc. – factors that might eventually lead to the death of a colony. Of the numerous studies conducted on this subject, many actually identified sublethal effects (e.g. behavioral changes). It is important to bear in mind, however, that almost all of these studies were either carried out with exposure concentrations that were higher than those bees would encounter under realistic field conditions, or conducted under otherwise unrealistic exposure conditions, e.g. in a laboratory or with forced feeding. Furthermore, many of these studies only involved tests done on individual bees outside the colony. Such studies do no correspond to natural conditions either, as it is known that colony effects cannot be readily extrapolated from the effects on individual bees.



Finally, many of the test protocols used in these studies have not been fully developed or validated by multiple parallel tests carried out by different test facilities. This ring test approach in the method development of testing designs is considered mandatory for valid regulatory tests, demonstrating that the test results can be reproduced. Hence, it must be emphasized that there are no studies conducted under realistic usage and environmental conditions that prove a honey bee colony has been harmed as a result of sublethal effects caused by a neonicotinoid.

Similarly, there is no real evidence of harmful effects caused by a combination of exposure to neonicotinoids and pathogen infestations at colony level under real-life conditions. Some studies have described effects that have been interpreted as interactions between neonicotinoids and pathogens in individual bees in the laboratory but these effects could not be confirmed in any studies so far conducted in bee colonies in the field under realistic exposure conditions (e.g. Pettis et al. 2012).

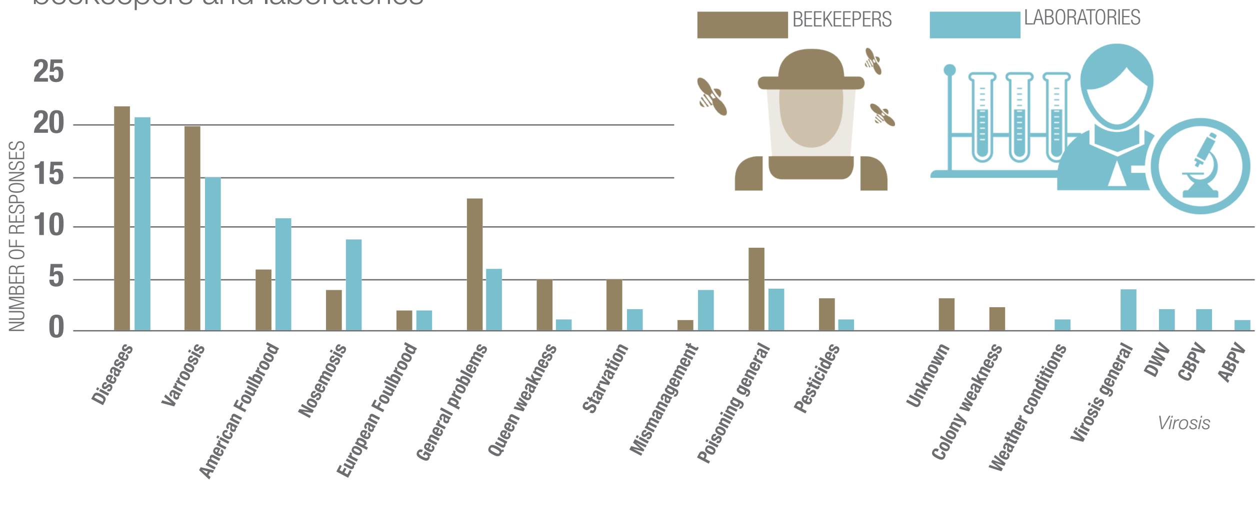
Guttation droplet residues

A few years ago, concerns were raised that neonicotinoid residues in guttation droplets produced by seed-treated plants might lead to bee poisoning. It is true to say that in some crops high residue concentrations can be found in guttation droplets from seed-treated plants. However, extensive field studies conducted by research institutes, authorities and the

Main causes of bee colony mortality

That pesticides are apparently not a key factor in bee mortality in Europe is also confirmed by a survey conducted by the EU Reference Laboratory for Bee Health in numerous European countries. According to this survey, *Varroa* and other disease pathogens are seen as the main cause of colony losses by beekeepers and scientists at reference laboratories, whereas crop protection products are considered to be of lesser importance (Chauzat et al. 2013).

Main causes of colony mortality reported by beekeepers and laboratories



Deflectors can reduce the emission of seed treatment dust by 90 percent.

industry have shown that guttation droplets are generally of little relevance as a source of water for honey bee colonies under realistic field conditions. In other words, exposure via this route only takes place in exceptional cases and in none of the cases examined (Pistorius et al. 2012) was any damage to the exposed colonies recorded.

This indicates that insecticide users, in general, are complying with the stipulated risk mitigation measures.

Past incidents, current improvements

Only very rarely have incidents occurred in which honey bees have been harmed by the use of neonicotinoids. One such incident happened in 2008 in southwest Germany when a number of honey bee colonies were harmed due to abraded dust from treated corn seed (Pistorius et al. 2009). Such cases are quite rare and generally due to accidents caused by inappropriate handling of seed treatment products. The incident in 2008, for example, was caused by non-compliance with best practices in the seed treatment process, which impaired the insecticide's adhesion to the treated seed. The crop protection industry has recognized this problem and has been working hand-in-hand with authorities, seed producers, machine manufacturers and research institutes to come up with technical solutions to improve seed treatments and planting machines. The significant successes achieved thus far have considerably improved the environmental safety of seed treatments and drastically reduced the environmental exposure from dust emissions from treated seeds (e.g. Friessleben et al. 2010, Forster et al. 2012). Field studies show that seeds treated according to the relevant quality standards can be sown safely without any problems. Additional optimization measures to further improve safety margins are under development.

There are few reports of accidents resulting from the incorrect application of neonicotinoid foliar products. The results of the surveys of plant protection product-related bee poisoning incidents carried out by state authorities in some countries show that the number of cases of bee poisoning in Europe has generally been steadily declining over the years (Thompson & Thorbahn 2009).

Large-scale monitoring projects

Important scientific results on the safety of neonicotinoids were obtained from various large-scale monitoring projects on bee health. In order to investigate honey bee colony losses, many monitoring projects in recent years have examined bee colony losses and possible causal factors under realistic field conditions. For example, a German Bee Monitoring Project (DeBiMo), one of the world's largest, has been regularly surveying approx. 12,500 bee colonies throughout the country since 2004 (Genersch et al. 2010). Monitoring projects and studies have been conducted in many countries of Europe and North America (e.g. van Engelsdorp et al. 2009, 2010, Rogers & Kemp 2004, Nguyen et al. 2009, Chauzat et al. 2009).

What all these approaches have in common is that they examine bee health *in situ* under realistic field conditions and over a relatively large geographical area, and that they aim to identify and study correlations between the health or mortality of honey bee colonies and relevant influencing factors. One factor studied in many monitoring projects is the possible link between the use of crop protection products, particularly neonicotinoids, and honey bee colony mortality by examining pesticide residues in beehives and exposure to crops treated with neonicotinoids. The results of these projects point to an absence of any correlation between residues of neonicotinoids or other pesticides in beehives and increased mortality of bee colonies. Moreover, there is no evidence of any systematic correlation between colony mortality and exposure to crops typically treated with neonicotinoids.

Restrictions by the European Commission

In 2013, the European Food Safety Authority (EFSA) published a new assessment of the risk to bees from imidacloprid, thiamethoxam and clothianidin seed and granular treatments. This was followed by an assessment for foliar uses of the same compounds in 2015. In its conclusions, the EFSA indicated that, in their opinion, the existing data sets had various gaps and some risk posed by the respective uses could therefore not be ruled out. It has to be said, however, that these EFSA assessments have been much criticized because of numerous shortcomings and inadequacies.

On the basis of this EFSA evaluation, which was not supported by the competent authorities of many EU Member States, the EU Commission imposed a restriction on the use of the above-mentioned neonicotinoids in crops attractive to bees in 2013 – despite the fact that no qualified majority in favor of this step was reached among EU Member States after two rounds of votes in the Standing Committee. The Commission went far beyond the concerns raised by the EFSA by also prohibiting a number of applications that had not even been evaluated by the EFSA at that time and which had never been linked to honey bee mortality. From the perspective of the crop protection industry the usage restrictions are not based on serious scientific principles and are therefore unjustified.

Bayer has brought the restriction on neonicotinoid uses before the General Court of the European Union to obtain a decision which provides guidance and clarity on the regulatory framework with respect to future investment decisions.

Closing the data gap

In the context of the EFSA re-evaluations, EU authorities have explicitly called on stakeholders, such as the registration holders of the affected products, to deliver within two years any additional data that might be helpful for a new and more accurate risk evaluation of neonicotinoids. In response to this call, the industry conducted or funded numerous new studies to fill the perceived data gaps and further improve our understanding of the bee safety of the neonicotinoids.

Bayer has brought the restriction on neonicotinoid uses before the General Court of the European Union to obtain a ruling on the legal basis of the European Commission's decision, as it was derived from an EFSA assessment based on a risk assessment scheme that was neither validated nor officially implemented. First and foremost, Bayer wants to obtain guidance and clarity on the regulatory framework with respect to future investment decisions.

Restrictions may finally be harmful to bee health

There is no reason to believe that the restrictions on the use of neonicotinoids imposed within the EU will improve honey bee health. Colony losses in the first years following the imposition of restrictions do not indicate any improvement of honey bee health. Moreover, the loss of insecticidal seed treatments for major crops has led to more extensive use of foliar applications of insecticides, which may lead to an increased exposure of non-target organisms to crop protection products.

There is also reason to fear that without seed treatments, the cultivation of some important bee forage crops, e.g. oilseed rape, will no longer be profitable in some regions of Europe. As a result, farmers will turn to other crops that are not attractive to bees and that, in turn, might have a negative impact on bee forage availability.

Non-European countries don’t follow suit

It should be added that by the summer of 2016, two and a half years after the restrictions in the EU were introduced, no country outside Europe has enacted similar restrictions on these substances. This is despite the fact that the bee safety of neonicotinoids has been intensively discussed in countries outside the EU, and non-EU states have also carried out formal re-evaluations.

In non-EU countries where neonicotinoids are intensively used in agriculture and the bee safety of neonicotinoids has also been subject to a thorough examination, authorities came to fundamentally different conclusions than those of the European regulators.

The US and Canadian authorities (USEPA and PMRA) concluded that the neonicotinoid seed treatments under discussion in Europe do not pose an unacceptable risk to bees. The Australian authorities (APVMA) even concluded that the introduction of neonicotinoids has led to an overall reduction in risks to the agricultural environment from the application of insecticides (APVMA, 2014).

Conclusions

Honey bee health is influenced by many different factors. On the basis of available data, the main negative influences in Europe and North America appear to be the parasitic *Varroa* mite and viral diseases. Despite this, crop protection products, and neonicotinoid insecticides in particular, play a predominant role in the public perception of the problem. Crop protection products have to undergo extensive ecotoxicological tests, including numerous in-depth tests involving bees, before they can be authorized. Neonicotinoids in particular have been subjected to very thorough and intensive testing procedures ranging from simple laboratory tests to field studies, some of which were conducted over several years under realistic agricultural conditions.

In no study with realistic exposure scenarios have harmful effects on honey bee colonies ever been observed.

Nor has a systematic spatial or time-related correlation been found between the use of neonicotinoids and increased honey bee colony mortality in numerous monitoring projects. The existing, extensive data of relevance to the assessment of a possible risk under realistic exposure conditions consistently suggests that neonicotinoids, if used responsibly and in accordance with usage recommendations, do not represent an unacceptable risk to bees and other pollinators.

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The Bee Health Magazine – our partnerships and projects.


NEW FOCUS IN TESTING BEE POLLINATORS

PROTECTING BEES FOR GENERATIONS TO COME

Crop protection product research, as well as introducing new products to the market, is subject to strict regulations. The experts at Bayer have to make certain that their products are safe for bees, when used correctly. This is why they are also carrying out laboratory studies on the younger generation of these insects – honey bee larvae. In the future more tests – both in the laboratory and the field – will be conducted to develop methods for bumble bees and wild bees.

Dr Maria Teresa Almanza
Head of the Bee Testing and Risk Assessment Group of Environmental Safety at Bayer

"We are constantly investigating new testing methods to ensure we are protecting bees based on up-to-date scientific approaches."

Farmers benefit greatly from the pollination services provided by honey bees, but at the same time they have to protect their crops against weeds, fungal diseases and harmful insects. Crop protection products, thus, play an essential role in farming. The products should be as selective as possible, to ensure they are safe to the environment, and especially to beneficial organisms, but can still control pests. This situation presents a challenge for plant protection researchers. Crop protection products have to comply with strict regulations before they receive approval: A specific use of every product must be safe for honey bees – and the standards are steadily increasing. "To meet these evolving requirements, we work with international experts on developing new procedures that allow us to optimize the safety testing of crop protection products," says Dr Maria Teresa Almanza, Head of the Bee Testing and Risk Assessment Group of Environmental Safety at Bayer. The entomologist and her team study the bees' sensitivity to crop protection products.

It has long been obligatory in the European Union and in many other parts of the world for crop protection products to be tested on adult honey bees before they can enter the market. But less has been known about how these products affect the bee brood, in particular the larvae and this has subsequently been taken up in the scientific and regulatory communities. "There are cases where testing of adult bees alone would not cover all relevant aspects of the ecotoxicological profile of a substance," says Dr Almanza.

This is why Bayer bee experts have teamed up with international experts since 2006 to investigate laboratory procedures that bring the bee larvae into direct contact with the substances. "This larvae test complements the toolbox of first-tier testing methods which are conducted in the laboratory under standardized conditions, and aims to gain information about the intrinsic toxicity of the tested substances," says the bee laboratory director Dr David Gladbach. To work out exactly how these types of tests should be conducted, several institutions carry out preliminary research. In most cases, these so-called ring tests involve various separate laboratories from industry and research working together, with the key objective to generate robust and reproducible data. The final result may be an official guideline. In 2013, the International Organisation for Economic Co-operation and Development (OECD) published the acute larvae test as "Test guidance document 237"

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AT A GLANCE

// Bayer experts test crop protection products on honey bee larvae to optimize the safe use directions for the products in the field.
// Prescribed standardized test procedures ensure that studies are comparable across different laboratories.
// The researchers are also developing new testing methods for wild bees and bumble bees.

Dr David Gladbach
Bee Laboratory Director

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