POLLINIS

A NONPROFIT AND INDEPENDENT ORGANIZATION THAT CAMPAIGNS FOR SUSTAINABLE FARMING IN EUROPE. POLLINIS FIGHTS AGAINST THE SYSTEMATIC USE OF PESTICIDES, FOR THE PROTECTION OF POLLINATORS AND PROMOTES ALTERNATIVE AGRICULTURAL PRACTICES. WE ARE SUPPORTED EXCLUSIVELY BY DONATIONS FROM PRIVATE INDIVIDUALS.

Neonicotinoids : Is a Total Ban in Sight ?

CONFERENCE PROCEEDINGS

DEBATES - INTERVIEWS

EUROPEAN PARLIAMENT IN BRUSSELS
7 NOVEMBER 2017

Event organised by POLLINIS

S&D Group of the Progressive Alliance of Socialists & Democrats in the European Parliament

European Parliament

WHY HAVE A CONFERENCE ON THE PROHIBITION OF NEONICOTINOIDS?

The conference "Neonicotinoids: Is a Total Ban in Sight? ", organised by the NGO POLLINIS, was held on Tuesday, 7 November, 2017 at the European Parliament in Brussels. Supported by Eric Andrieu, French MEP and S&D Spokesman for Agriculture and Rural Development in Parliament, the event brought together five leading scientists who presented their recent work on the impact of these pesticides on bees and ecosystems: Hans de Kroon, Caspar Hallmann, Peter Neumann, Fabio Sgolastra, and Jean-Marc Bonmatin.

The time is right: EFSA, the European Health Agency, is preparing to publish its study report on neonicotinoids. The Commission will also submit a legislative proposal to the Member States for a vote before the end of the year. In the summer of 2016, France already adopted a total ban on these active substances, which is due to enter into force in September 2018.

Neonicotinoids are a class of neurotoxic insecticides (which attack the central nervous system of insects, causing paralysis and death). There are seven (acetamiprid, clothianidin, dinotefuran, imidacloprid, nitenpyram, thiacloprid, thiamethoxam), these active molecules appeared in the 1990s and are today the most common type of insecticide used in Europe on field crops (corn, rapeseed, sunflower, but also beetroot, potatoes, etc.). These pesticides are broad-spectrum - they kill all arthropods indiscriminately - and are systemic: they are transported by the sap of the plant into pollen and nectar as it grows.

While the fate of these neurotoxins is being decided in Europe, the researchers faced with the massive disappearance of insects have called on the European Union to take urgent measures.

POLLINIS is an independent, non-profit NGO that works exclusively through donations from citizens, to protect honey bees and wild bees, and for an agriculture that respects all pollinators. Since its foundation in 2012, the NGO has been calling for a total prohibition on neonicotinoids in Europe. They have submitted a petition to this effect with more than 1.3 million signatories to the European Parliament and the European Commission.

"BEYOND THE DAMAGE TO BIODIVERSITY AND THE ENVIRONMENT, IT APPEARS THAT OUR FOOD SYSTEM IS IN DANGER. IT IS NOW UP TO POLITICIANS TO STEP IN. THERE IS AN URGENT NEED TO BEGIN THE TRANSITION FROM THE PRODUCTIVE AGRICULTURAL SYSTEM TO AGROECOLOGY. NEONICOTINOIDS MUST BE BANNED AND REPLACED, NOT BY OTHER TOXIC CHEMICAL MOLECULES, BUT BY EXISTING AND PROVEN AGRONOMIC AND ORGANISATIONAL PRACTICES." Nicolas Laarman, general delegate of POLLINIS.

SUMMARY

NEONICOTINOIDS: IS A TOTAL BAN IN SIGHT?

SOME INTRODUCTORY WORDS

ÉRIC ANDRIEU

MEP, spokesperson of the European Social Democrats for Agriculture and Rural Development in the European Parliament

When I agreed to sponsor this meeting five months ago, I didn't think the issue would be so topical. [...] especially glyphosate this week. [...] At the same time as regards the European Parliament, even if the subject is not exactly the same but similar, the Conference of Presidents of Parliament must decide whether or not to set up a special committee with regard to the Monsanto Papers case. [...]

In France, the Future Generations association must file an appeal today to the Council of State against the pesticide application order near homes, saying that this second version of the decree - which has already been cancelled for the first time - lacks ambition and was drafted under the pressure of lobbies.

France also became the 8th European country to authorise two pesticides made from sulfoxaflor, a molecule which has been identified as toxic to bees by a report from theEuropean Food Safety Authority (EFSA) in 2014, of which France was itself a co-rapporteur. And as you know, the French National Agency for Health Safety (ANSES) now has three months to confirm or reject the authorisation of these two pesticides.

Finally there was **the publication on 18 October of the Dutch study by Professor Hans de Kroon and Caspar Hallmann on the disappearance of nearly 80% of insects in Europe** - which is not a light matter. They do us the privilege and honour of being with us today. And I want to thank them as well as the professors and the doctors, Neumann, Sgolastra and Bonmatin. Thank you for having accepted our invitation for this exchange, this debate, which will undoubtedly be very constructive, given that the situation is worrying today.

Given the importance of this subject, I can only regret the absence of the European Commission and the European Commissioner for Health, Mr Andriukaitis, whom I tried to convince of the need for this debate today but who was unable to attend this meeting. I regret this all the more because the same European Commission, in a report published on 10 October, expressed the troubling view that if pesticides, and I quote, are used in accordance with the permitted conditions of use, they have no proven harmful effects on human and animal health or any unacceptable effects on the environment. And I think it would have been interesting at this time to exchange views on this statement.

I also regret that EFSA - who also promised to be here among us [...] and who took a strong position on the subject of neonicotinoids* - was not able to be here today. But that's the way it is and it's all the more unfortunate, and this is my introductory comment, **that this debate is not intended to pit environment associations against farmers or their representatives,** but rather to

try to exchange and understand, because **farmers are the first to be threatened by neonicotinoids** and by the bee mortality rate which is as high as 80%, we are told, in some hives in Europe. Threatened, because these bees (in fact all wild and domestic pollinators) pollinate 84% of European crops and 4,000 varieties of plants, hence the importance of this meeting.

Accompanied by members of the POLLINIS association (Clementine Bonvarlet on the left and Julie Pêcheur on the right), French MEP Éric Andrieu sponsored the conference on the prohibition of neonicotinoids in the European Parliament.

JULIE PÊCHEUR

Director of POLLINIS Campaigns

POLLINIS is a non-profit NGO, which aims to protect bees and promote sustainable agriculture, in order to preserve pollinators. It is important to note that the association is exclusively funded by donations from individuals and not by governments or corporations. The studies that we carry out and the projects that we accompany serve as support to inform the general public, through awareness campaigns and petitions. POLLINIS was founded in

2012, when the European Union began considering prohibiting neonicotinoids. Our first campaign was about the total prohibition of the seven active substances. The partial prohibition voted by the European Union did not seem sufficient to us. And in fact the following year, the use of neonicotinoids in France surged by 31%!

Our petition for a total ban on these pesticides has collected more than 1.3 million signatures across Europe. It is on behalf of these 1.3 million European citizens that we organised this conference. **Europeans are worried about how pesticides affect their health, the quality of their food, the environment...** Let us not forget that it is the citizens who finance agriculture, indirectly contributing to the Common Agricultural Policy (CAP), which represents the largest budget in Europe.

This conference comes at a crucial moment: the European Food Safety Authority (EFSA) has just sent the European Commission a report on the impact of three neonicotinoids on bees based on a series of scientific studies published since 2012. Before the end of 2017, the Commission will submit legislative proposals to Member States to vote to lift, maintain or extend the prohibition in force. Last summer, France took the courageous and historic decision to prohibit all pesticides containing neonicotinoids, a prohibition that will be put into action in a few months. Europe must go down the same path and take into consideration the widespread opposition of European citizens to the massive and systemic use of pesticides. The extent of destruction caused by pesticides on ecosystems puts our food security at risk. **The use of neonicotinoids, or equally toxic pesticides, such as the recently authorised sulfoxaflor, is leading to a technical and economic impasse in agriculture.**

It is time to embark on a profound agricultural transition, based on agroecology and models that can feed a growing population while preserving the health of citizens, pollinators and ecosystems. It's time to listen to the citizens and to science.

CLÉMENTINE BONVARLET

Communication Officer and Moderator, for POLLINIS

This conference brings together a panel of experts on systemic pesticides (pesticides carried by the sap of the plant into pollen and nectar as it grows). They will present their latest studies and the impacts of these pesticides, particularly neonicotinoids, on biodiversity, pollinators and the ecosystems on which they depend.

This event is a valuable opportunity to alert decision-makers to the consequences of widespread use of systemic pesticides. But more importantly, it provides a platform for effective agronomic and organisational alternatives, on which the EU will need to build in order to initiate an agro-ecological transition and guarantee food security for its citizens.

From left to right: Italian researcher Fabio Sgolastra and French Jean-Marc Bonmatin, moderator Clémentine Bonvarlet, MEP Eric Andrieu, Pollinis general delegate Nicolas Laarman, Dutch researchers Hans de Kroon and Caspar Hallmann.

I. NEONICOTINOIDS, BIRDS AND THE DECLINE OF FLYING INSECTS

By Professor Hans de Kroon & Caspar Hallmann

Summary of the presentation A first study shows that the presence of neonicotinoids in the environment disrupts ecosystems and affects bird populations. In the Netherlands, areas of population decline in 15 species of insectivorous birds are associated with the presence of neonicotinoids. The use of these insecticides actually leads to a decrease in insect populations, which in turn affects bird reproduction. A second study reveals that more than 75% of flying insects have disappeared from Germany in less than 30 years. This dramatic decline, undoubtedly all over Europe, has been highlighted in protected natural areas. The causes of this massive decline are to be found on the side of agricultural practices: insufficient floral resources and use of insecticides.

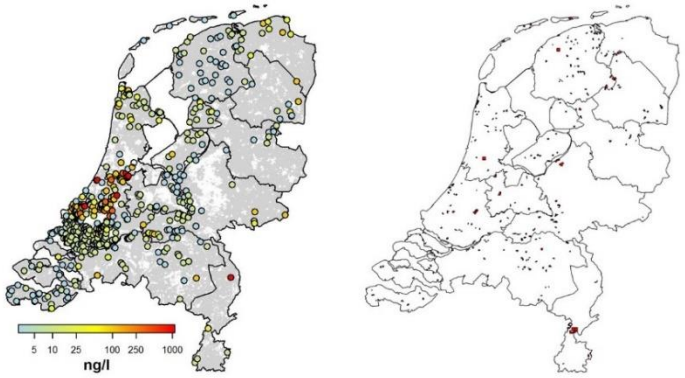
- Professor in Plant Ecology,
- Director of the Research Institute on Water and Wetlands, Radboud University Nijmegen, The Netherlands,
- Research Director of Caspar Hallmann.

Professor Hans de Kroon works on plants and their ability to find water and food, especially in the underground environment via root systems. He works on dynamic population models for a wide variety of plant species. He is the co-author of a 2014 study with Caspar Hallmann on the decline of insectivorous birds, a consequence of the use of neonicotinoids in the environments studied.

- PhD student in ecology at the Research Institute of Water and Wetlands at Radboud University.

Caspar Hallmann works on population dynamics. His area of specialisation is the modelling of ecological processes for better management and protection of threatened species. He is the co-author of the recent study published in the scientific journal PLOS One entitled **"Over 75% decline over 27 years in total biomass of flying insects in protected areas".**

PRESENTATION



→ Decline of insectivorous bird populations in the presence of neonicotinoids: left, concentration of imidacloprid in Dutch surface waters in ng / L, right, decline of insectivorous bird populations in agricultural areas.

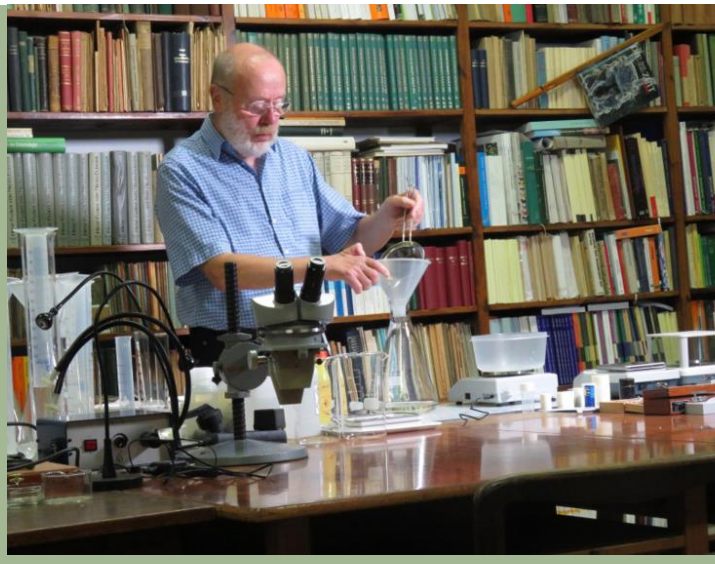
We carried out a study on the decline of insect populations. The Netherlands has high concentrations of neonicotinoids. On the first map, you can see how much **our rural areas are now contaminated with neonicotinoids.** The second shows data for 15 species of insectivorous birds. These are bird species with known population status, behavior and health status. [...] **The areas of decline of these populations are associated with the presence of neonicotinoids.** In areas where imidacloprid concentrations are low, bird population growth is optimal, while in areas where the pesticide is present in higher concentrations, bird populations are clearly declining. At first we were very surprised by these results. But at the same time and for the first time, **we have been able to demonstrate that the presence of neonicotinoids in the environment disrupts ecosystems and impacts bird populations.**

[...] It is not directly the effects of toxicity [of neonicotinoids] that are being questioned but their impact on food supplies. [...] The use of neonicotinoids leads to a decrease in insect populations, which in turn impacts bird reproduction. But have insect populations really declined in recent centuries? We reached out to entomologists from the Krefeld association who studied insects by setting traps in 63 natural environments,[1] mainly in Germany, and monitored them over nearly 30 years. **We now have data that confirms that insect populations have indeed declined.**

[1] Several sites were studied: Natura 2000 (37 sites), Nature reserves (7), Protected natural areas with conservation measures (9), Water protection zones (6), Natural habitat zones protected by regional associations (4)

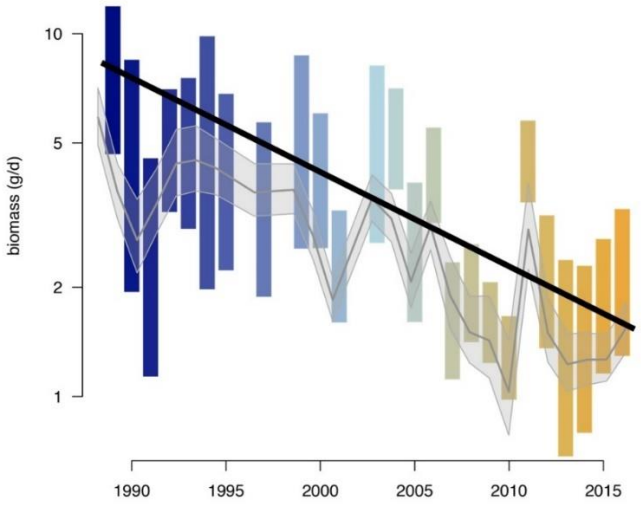
Two examples of nature reserves selected to study insect biomass.

→ Studies of great diversity have been conducted. On the left for example, a wet reserve, with an abundance of flowers, rich and naturally full of insects. On the right, a drier natural environment. We have here a very complete image of landscapes likely to receive insects.



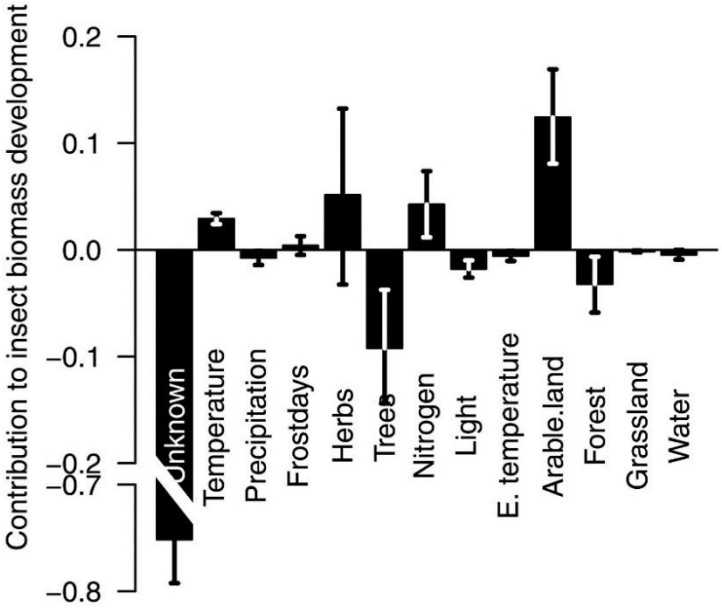
A weighing of the insects harvested determines the evolution of their biomass over the years.

→ What has been done in these areas: positioning structures that you can see on the left, to capture insects. On the right: a member of the laboratory of the entomological association doing a weighing according to a standardised procedure. This rigorous process allowed us to obtain a number of standardised data that we were able to analyse.



→ **Insect decline from 1990 to 2015:** highlighting the dramatic decline in insect populations over time.

Here we see a continuing decline in insect populations. […] This corresponds to an eradication effect. […] But globally **the decline is greater than 75%. And in the middle of the summer, this increases to 80%. This is a dramatic decline that is underway and highlighted in these nature reserves.**



→ **Contribution of different factors to insect development (biomass):** different environmental factors influence insect development. But at this stage of the analysis, the main factor of decline remains unknown.

To analyse the factors of decline, one can rely on the diagram (above), which represents different factors that may contribute to the development or decline of insects. For example, the rise in temperatures in Germany, as in the rest of Europe, has had a moderate but measurable impact on insects.
However, the factors identified, whatever their impacts, are not enough to explain the decline of insect populations. In fact, the main cause of insect decline is still unknown.

How can we explain it? Look at the picture below, which represents a typical European semi-natural space.

This is a site selected for insect counting in Germany.

→ The small tent is used to capture insects. Around it, you can see an islet with swampy grass, frogs, an environment neither too dry nor too humid. Everything looks perfect. In reality, this is probably not the case for the insects. Look more closely: **this small nature reserve is surrounded by an agricultural area**. In the distance, there is nothing favourable for insects. It is rather a hostile environment. Natural habitats are confined to agricultural land, which interrupts the continuity of ecosystems and thus isolates flying insects from each other and their food supplies. We think that's the real problem. **This small reserve is captive of an intensive agricultural landscape.**

So what can we do? Of course, we need to find the exact causes of the decline. Are pesticides alone the cause? The intensification of agriculture? Undersized natural areas? We must address different issues. First, determine the ecological consequences of this decline, taking into account the effects already observed on birds. These ecological consequences are extremely important. Then we have to look at the resilience of the system. Finally, we must determine the geographical extent of the decline, at a European level. I encourage the Krefeld Association to continue monitoring the data that will help us identify the problem. **We need to know what's going on before it's too late. But that's not all: we must act now too.**

Among the views expressed in the press, an alarming article from the Guardian and another from *Monde* remind that it is time to act and change things. They underline the fragile and unsustainable functioning of the dominant agricultural model... In conclusion, we must do something**. Pressuring politicians is essential.**

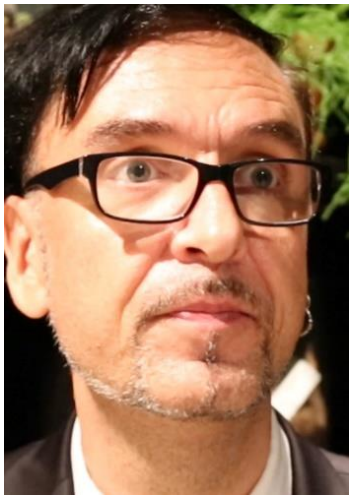
According to the headlines of the newspaper *Die Zeit*Angela Merkel has already read about our studies... This is good news. Our Minister of Agriculture has also expressed concern about the decline of insects. She was here in Brussels yesterday and included these issues on her agenda and that of her counterparts, the agriculture ministers of the various EU states. Politicians are starting to be placed under pressure, and that is a priority.

The disappearance of over 75% of winged insects requires immediate action and I hope that you are convinced that this is now a necessity.

II. ECOSYSTEM AND NEONICOTINOID SERVICES

By Professor Peter Neumann

Summary of the presentation Neonicotinoids affect the fertility and performance of queens and male bees, affecting the entire colony. These pesticides also affect the health of honeybees whose females give birth to fewer and less efficient males. They therefore have an impact on pollination. But these substances also affect many underground and aquatic organisms that provide other basic ecosystem services. More than 550 studies show that the widespread and prophylactic use of neonicotinoids has severe consequences on non-target species. This corpus reflects a genuine scientific consensus. There is enough scientific evidence today to conclude that there is need for immediate action.



- Professor at the Bee Health Institute at the University of Bern, Switzerland
- Chair of the Working Group on Ecosystem Services, Agriculture and Neonicotinoids, European Academic Science Advisory Board,
- President of the COLOSS association (prevention of bee colony mortality), an international association working to improve the well-being of bees
- Vice President of COST Action SUPER-B (Sustainable Pollination in Europe - joint research on bees and other pollinators) which currently has 30 member countries.

The research covers all aspects of bee health, with an emphasis on the behavioural, evolutionary and molecular ecology of honeybees and their pathogens. Its working group published a report in 2015 indicating that there was "growing evidence" that neonicotinoids have "severe negative effects on non-target organisms".

PRESENTATION

According to our research on neonicotinoids, these pesticides are real poisons. When we talk about poison, what comes to mind is its deadly toxic effects [...]. Perhaps certain effects are best described when they lead to the death of organisms. However, as far as neonicotinoids are concerned, some effects do not directly lead to death: they are said to be sublethal but nonetheless significant.

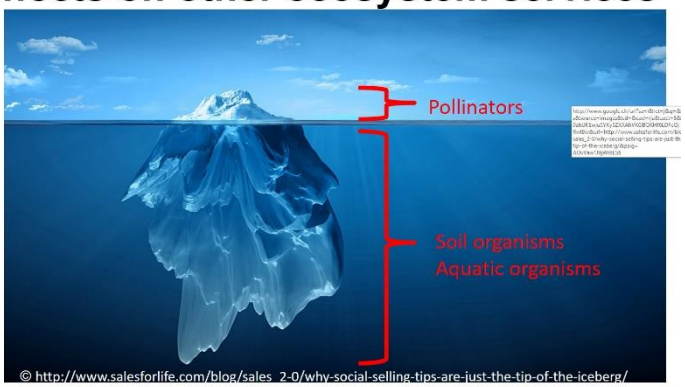
According to our research, if the insect population is in serious decline, it is for a logical, almost mechanical reason: **insects are reproducing less**. **We have highlighted the impact of neonicotinoids in the decline of fertility of queen bees.** And of course this has dramatic consequences, since queens have a monopoly on reproduction. When a queen is in trouble, the whole colony is threatened.

Similarly, it appears that male bee semen (or drones) is altered by these pesticides. **Neonicotinoids therefore also reduce the fertility of males.** If both breeding males and queens in honey bee colonies can be affected, [...] **what about wild bee species?**

By studying *Osmia Cornuta* bees (mason bees), we have shown that neonicotinoids also affect the health of solitary bees. The impacts on honey bee fertility are very difficult to assess, because there are many different species and they are very social. They grow in large colonies. In solitary bees, [...] we have highlighted these impacts in a more detailed way: a smaller number of offspring, with a lower body weight. **The bee is healthy if it is able to lay many eggs throughout its life. However the sex ratio (ratio between male and female individuals at birth) is altered (under the effect of neonicotinoids): females give birth to fewer and less efficient males.** It's quite incredible: when they are sick, the females modify their reproduction accordingly. This gives us a possible and fairly logical explanation of the mechanism of bee decline.

What do a honey bee and a polar bear have in common? First of all, they have a lot in common ... The threats hanging over the polar bear are in all things related to global warming. Its disappearance affects us, because a polar bear is beautiful, it's adorable. However, there are thousands of other species adapted to extreme cold conditions that suffer from global warming in the polar environment: crustaceans, seals, etc... But polar bears are the most effective at drawing public attention to the problem of climate change. **Honeybees, like polar bears, are popular. People find them appealing because they are useful, hardworking, and make honey.** [...] It's a good thing that bees draw attention to the fate of insects, it's important. But **the protection of domestic honey bees is not sufficient to preserve the pollination service, or other ecosystem services.** And it's the same problem with polar bears: protecting polar bears alone is not enough to save a polar ecosystem.

Effects on other ecosystem services



→ **Illustrative proportions of the different organisms affected by neonicotinoids:** we find significant concentrations of neonicotinoids in soil and water; the impacts do not only concern pollinators, but also soil organisms and aquatic organisms.

(Neumann et al., 2015)

To continue the analogy with the polar circle, let's continue with the image of an iceberg. Its emergent part represents only a small part of its volume: it represents the pollinators. Bees and other pollinating insects are very important. But **if you consider the impact of neonicotinoids, it is very likely that a large part is the submerged part of the iceberg: the living underground and aquatic organisms.** A high proportion of neonicotinoids leave the plants to migrate into the soil and into the water. The likelihood of them altering ecosystem services* other than pollination is high. **If you look at ecosystem services, you will think of insect pollination, but there are many others at least as important, if not moreso.**

[...] I would like to give you some examples of the main types of ecosystem services that are relevant to agriculture. Obviously pollinators - and there are many - honeybees and bumble bees, for example, take care of the sexual reproduction of flowers. But we also have a natural pest control service. Spiders, for example, who do not always have good press, do important work for the ecosystems and play an auxiliary role for crops, since they are the natural predators of insect pests [...] **I think that soil organisms and crop auxiliaries, for example, provide invaluable services that are not limited to pollination.** There are many more, and these are just a few examples.

I am pleased to congratulate the EASAC group [entity formed by the national academies of science EU Member States/English European Academies Science Advisory Council], with whom **we conducted a meta-analysis that brings together all the publications on neonicotinoids and their possible impacts on ecosystem services. According to our report, there is compelling evidence that the widespread use of neonicotinoids has serious consequences for non-target species**. To date, the report contains 300 peer-reviewed articles and more than 550 articles in total. **This body of evidence reflects a genuine scientific consensus.** The prophylactic and systematic use of neonicotinoids is one of the major points to consider. [...]. **It is precisely because treatments are applied preventively, even when they are not necessary, that neonicotinoids are now everywhere.** [...] We are reaching a breaking point for bees. And I don't think that's surprising: insecticides are designed to kill insects. I would have been surprised if they had no impact. And if we put a lot of these substances into the environment, indeed, we should not be surprised to see a lot of effects.

"WE HAVE HIGHLIGHTED THE SERIOUS EFFECTS OF NEONICOTINOIDS ON NON-TARGET ORGANISMS, WHICH ALSO PROVIDE KEY ECOSYSTEM SERVICES. THESE EFFECTS ARE POTENTIALLY IMPORTANT, NOT ONLY FOR THE POLLINATION SERVICE BUT ALSO FOR A NUMBER OF OTHER ECOSYSTEM SERVICES. EVERYONE TALKS ABOUT BEES BUT FEW MENTION THE AUXILIARIES PRESENT IN THE SOIL, THE POPULATIONS OF WHICH ARE ALSO DECLINING, DESPITE THE FACT THAT THEY PROVIDE AN IMPORTANT SERVICE. THERE IS ENOUGH SCIENTIFIC EVIDENCE TODAY TO CONCLUDE THAT THERE IS A NEED FOR IMMEDIATE ACTION. " Peter Neumann

Easy to say, but more difficult when it comes to knowing what to do. There is a lot of debate going on as to whether neonicotinoids should be banned. However, we must also consider the consequences of them being prohibited: will these consequences be significant? Are there alternatives to the use of neonicotinoids and will they be available to farmers? How can they be compensated if profits decrease? Neonicotinoids act like a hunting weapon. They have a non-specific action and even affect non-target organisms by their action. This is inevitable. As with a sniper, we need a more targeted approach and substances to combat specific pests. In any case, we must discuss the consequences of the ban on neonicotinoids now, before it is implemented.

III. COCKTAIL EFFECT OF NEONICOTINOIDS AND FUNGICIDES ON BEES

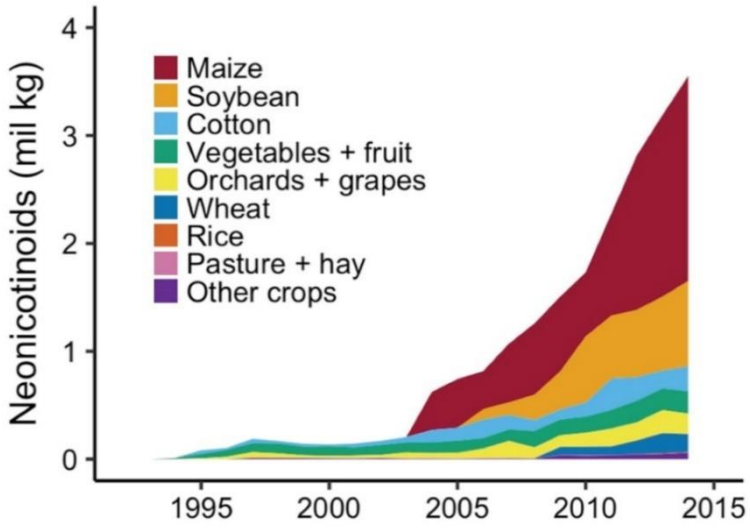
By Professor Fabio Sgolastra

Summary of the presentation The impacts of neonicotinoids on bees are generally evaluated alone, without taking into account their possible interactions with other substances. Now poisoned bees are often victims not of just one, but of a combination of at least two pesticide substances, most often a cocktail of neonicotinoids and fungicides. The impacts of synergistic effects are much greater on *Apis mellifera* but also on other species of wild bees. Neonicotinoids were introduced to the market in the early 1990s using an obsolete risk assessment system. The risk assessment of pesticides should be continuously updated.

- Researcher at the University of Bologna, Department of Agricultural Sciences, specialising in general and applied entomology
- Member of the COLOSS association
- Member of different working groups on bees at EFSA and more specifically on:
    - the "Beehave Model Evaluation" for the risk assessment of stressors in honey bees, in 2015
    - the "Guidance Document on the Risk Assessment of Plant Protection Products on Bees" (*Apis mellifera*, *Bombus spp.*. and solitary bees) in 2012-2013
    - the risk assessment for bees in 2011-2012
- Member of the Management Committee COST Action SUPER-B (Sustainable Pollination in Europe - joint research on bees and other pollinators) which currently has 30 member countries.

PRESENTATION

My research focuses on the effects of synergies between pesticides, particularly between neonicotinoids and fungicides, and their impacts on bees. We present today the consequences of what is known as the cocktail effect on bees.



→ **Evaluation of the quantity of neonicotinoids (in millions of kg) in different crops, between 1990 and 2015:** the use of neonicotinoids has increased exponentially in major crops.

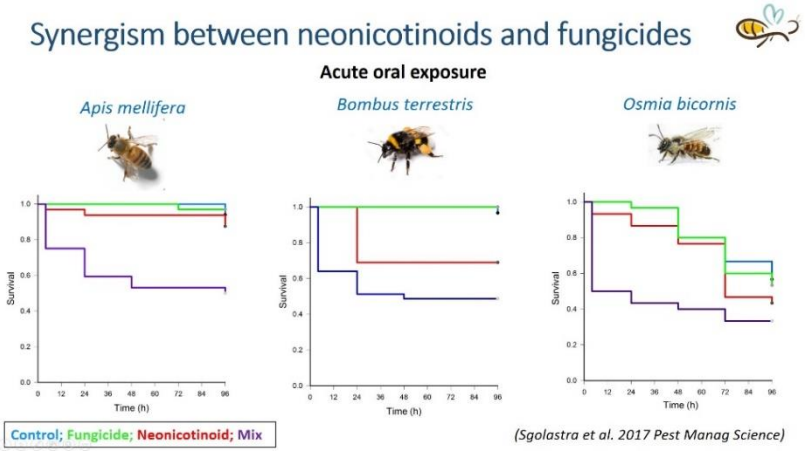
There has been exponential use of neonicotinoids, the most widely used group of pesticides in the world, over the past decade. At the same time, many negative effects on bees can be seen. First, sublethal effects: **Impacts on fertility, thermoregulation, learning ability or honey production ability**. But neonicotinoids can also act in combination with other pesticides. The presentation will focus on this specific problem.

In an urban or agricultural environment, bees are regularly exposed to many pesticides. On average, out of 100 pollen samples taken from bees, 40 are contaminated with two or more pesticides. If we analyse the bees' bodies this time, the number decreases: only 24% are contaminated by a mixture of pesticides. On the other hand, it is interesting to note that 85% of dead bees are contaminated by a mixture of at least two pesticides. **Poisoned bees are often the victims of not just one, but a combination of two or more pesticide substances.**

In Italy, more than 50% of the contaminated bee-matrices samples are contaminated by a mixture of pesticides, namely neonicotinoids and fungicides, and this is worrying. These combinations are common, fungicides are routinely sprayed at the time of flowering under the assumption they are safe of bees and residues of neonicotinoids are frenquently found in both nectar and pollen. **Most often bees are contaminated not by a substance, but by a combination of neonicotinoids and fungicides.** The impacts of neonicotinoids on bees are generally assessed alone, without taking into account their possible interactions with other substances. Yet we now know that **combinations of pesticides may have synergistic effects. The impacts of at least two combined pesticides are much greater than when these pesticides act individually.**

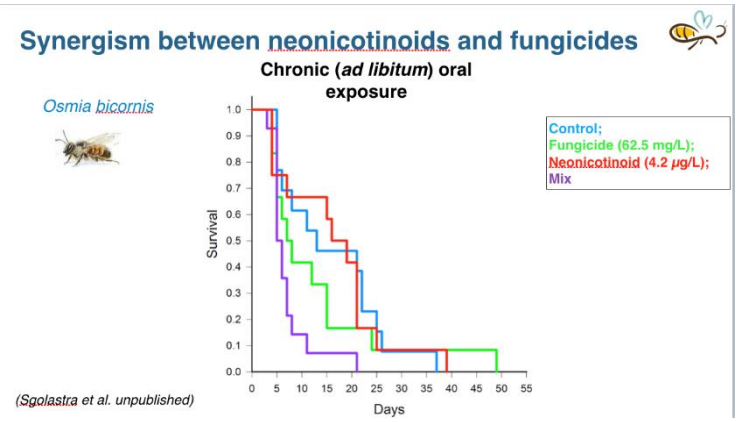
But 75% of the studies on the subject were conducted on a particular species of western bees, *Apis mellifera*. **There are around 20,000 bee species in the world, and most of them are solitary.**

This group of insects presents a diversity of behaviours, life cycles, physiologies... **This assumes that these different bee species are not sensitive to different chemical compounds in the same way.**



→ **Survival rate of three bee species in the presence of two pesticides alone or in combination:** the survival rate of the different bees drops drastically in the presence of neonicotinoids and accumulated fungicides.

We conducted a study in 2016 to analyse the impacts of neonicotinoids and fungicides on three bee species: two social species, *Apis mellifera and Bombus terrestris,* and a solitary species, *Osmia bicornis*. The bees were first exposed to a single dose of neonicotinoid, fungicide or a mixture of both. We observed the survival rate of bees during the first 96 hours after exposure. On the graphs (above), the blue line represents the control sample, not exposed to contamination and fed with a sugar water solution. The green line represents the surviving population on exposure to a sublethal dose of fungicides, the red one to a dose of neonicotinoids and the violet one to a mixture of both. There is **an extremely significant impact on bee mortality, linked to the combination and synergies of the two pesticides. The survival rate drops dramatically and populations collapse when the two pesticides are combined.**



→ **Survival rate of *Osmia bicornis* in the presence of two pesticides, alone or in combination, during chronic exposure:** the survival rate of *Osmia bicornis* drops drastically in the presence of neonicotinoids and cumulative fungicides.

However, in their natural environment, bees are exposed to lower, but more consistent, doses of pesticides throughout their lives. So, in 2017, we started a new study that is more in line with these conditions, to analyse the effects of chronic contamination where bees would be exposed to pesticides throughout their lives. The report concerns *Osmia bicornis* for now but studies on *Apis mellifera* and *Bombus terrestris* are underway. The results show that the survival rate over time varies little between the control population and those exposed to low concentrations of fungicides in particular. On the other hand, **in the presence of a low concentration of a mixture of the two substances, the survival rate of the bee drops dramatically.**

Then we observe the survival rate over time of bees exposed to a higher rate of neonicotinoids. Again, the two curves for neonicotinoids and fungicides are initially similar. But again when we observe a mixture of the two products (low fungicide concentration and slightly higher concentration of neonicotinoids next time), the survival rate of bees exposed to this mixture, literally collapses. At the end of the 6th day, all of the bees had died [compared to an average of 35 days for the control group]. **The impacts are catastrophic when bees are simultaneously exposed to neonicotinoids and fungicides.**

To conclude: neonicotinoids were introduced to the market in the early 1990s using **an "obsolete" risk assessment system**. This approval system did not take into account many parameters: for example, sublethal effects on queens, diversity of exposure modes: dust, guttation (drops that seep from plants). Nor did the studies consider synergies between substances and their impacts on different bees and other pollinators. However, **scientific studies suggest that neonicotinoids not only have significant sublethal effects on bees, but also even more damaging impacts when combined with other substances. The mixture of neonicotinoids and fungicides is becoming more and more frequent in European agricultural areas, and bees are increasingly exposed to these cocktail effects, and are not the only pollinating insects concerned.**

"THE RISK ASSESSMENT OF PESTICIDES SHOULD BE CONTINUOUSLY UPDATED, USING THE NEW SCIENTIFIC TECHNIQUES. AND I THINK EFSA'S ORIENTATION PAPER * (2013) IS AN IMPORTANT STEP IN THIS DIRECTION, NOT ONLY FOR THE EVALUATION OF NEONICOTINOIDS, BUT ALSO FOR THE EVALUATION OF FUTURE PESTICIDES [WHICH WOULD BE THE SUBJECT OF A MARKETING APPLICATION]. " Fabio Sgolastra

IV. NEONICOTINOIDS: EFFECTS ON BIODIVERSITY AND ECOSYSTEMS

→ the issue of highly toxic pesticides in the world

By Jean-Marc Bonmatin

Summary of the presentation Neonicotinoids act on the central nervous system, not only of insects but also of mammals. Their impact is greatest on pollinators, but also on soil invertebrates and all aquatic invertebrates. They also affect vertebrates, such as fish and common birds. The question arises as to their effects on mammals and in particular on humans. These molecules, which have contaminated the planet, pose a threat to public health. There is consensus on this point and there is an urgent need to act by giving priority to integrated pest management techniques and organic farming.

- Doctor in Chemistry-Physics,
- Researcher at the Department of Molecular Biophysics of the National Center for Scientific Research (CNRS) of Orléans,
- Vice-President of the Task Force on Systemic Pesticides, a working group created in 2009 to conduct research on the environmental impact of the use of neonicotinoids and their effects on biodiversity and ecosystems. He is the main author of WIA 2015 (Worldwide Integrated Assessment) which analysed more than 2 000 studies on neonicotinoids.

Jean-Marc Bonmatin's studies are located at the intersection of chemistry, biology and toxicology, and concern the contamination of living systems with pesticides (in particular neonicotinoids). He is about to publish a second meta-analysis on the subject.

PRESENTATION

My presentation will focus on the much broader effects of using systemic pesticides, particularly neonicotinoids, on biodiversity and ecosystems. [...] We will be talking about bees and imidacloprid, and the archetypal molecule of neonicotinoids. As you will see through my presentation, science has already done a great deal to illustrate the effects of these molecules.

Neonicotinoids are a small family of molecules that act on the central nervous system, not only of insects but also of mammals to a lesser extent. We can discuss the classification of these neonicotinoids at a later stage, if you wish. From the chemist's point of view, we consider two subclasses of neonicotinoids, including sulfoxaflor and flupyradifurone, which belong to the neonicotinoid class. Neonicotinoids are a dozen molecules that act on the central nervous system of insects to destroy them when used in agriculture. By blocking the ion channels, the insect is killed in seconds or minutes depending on its size.

We've done a great deal of research on this. To sum up: in 2014 on the internet and in 2015 in hard copy, we published a set of eight peer-reviewed scientific reports, which already raised the issue of the impact of neonicotinoids on biodiversity. Most recently, in 2017, we released a series of articles that update this global assessment - because we operate internationally -of the effects of neonicotinoids on biodiversity and ecosystems. So I'm going to focus a little more on the exposure issues of non-target organisms, that is, organisms that are not affected by the use of these pesticides. What are the consequences of their exposure on their metabolism? We will discuss insect and invertebrate populations, as well as vertebrates and the impacts these molecules have on ecosystems in general. Then we can open the debate to the question of resistance, i.e. all those molecules that have produced resistance in pests and are therefore less and less useful in the end. Finally, we can see that alternatives to neonicotinoids exist and are numerous. If you ask me, I can show you that certain alternatives are extremely effective and can replace the systematic and preventive use of these molecules.

Our work consisted of a global risk assessment. This requires two things: measuring actual exposures in the nature of non-target species, and measuring the effects. When you obtain both the exposure measure and the effects sensitivity measure, you can assess the risks, that's the definition. This then allows us to give advice on protecting pollinators but also ecosystems in general, and then, you will see, perhaps even public health.

Concerning bees, this has been heard and demonstrated for some years now. **Whether bees, bumblebees or wild pollinators, the four major threats that explain their decline are:**

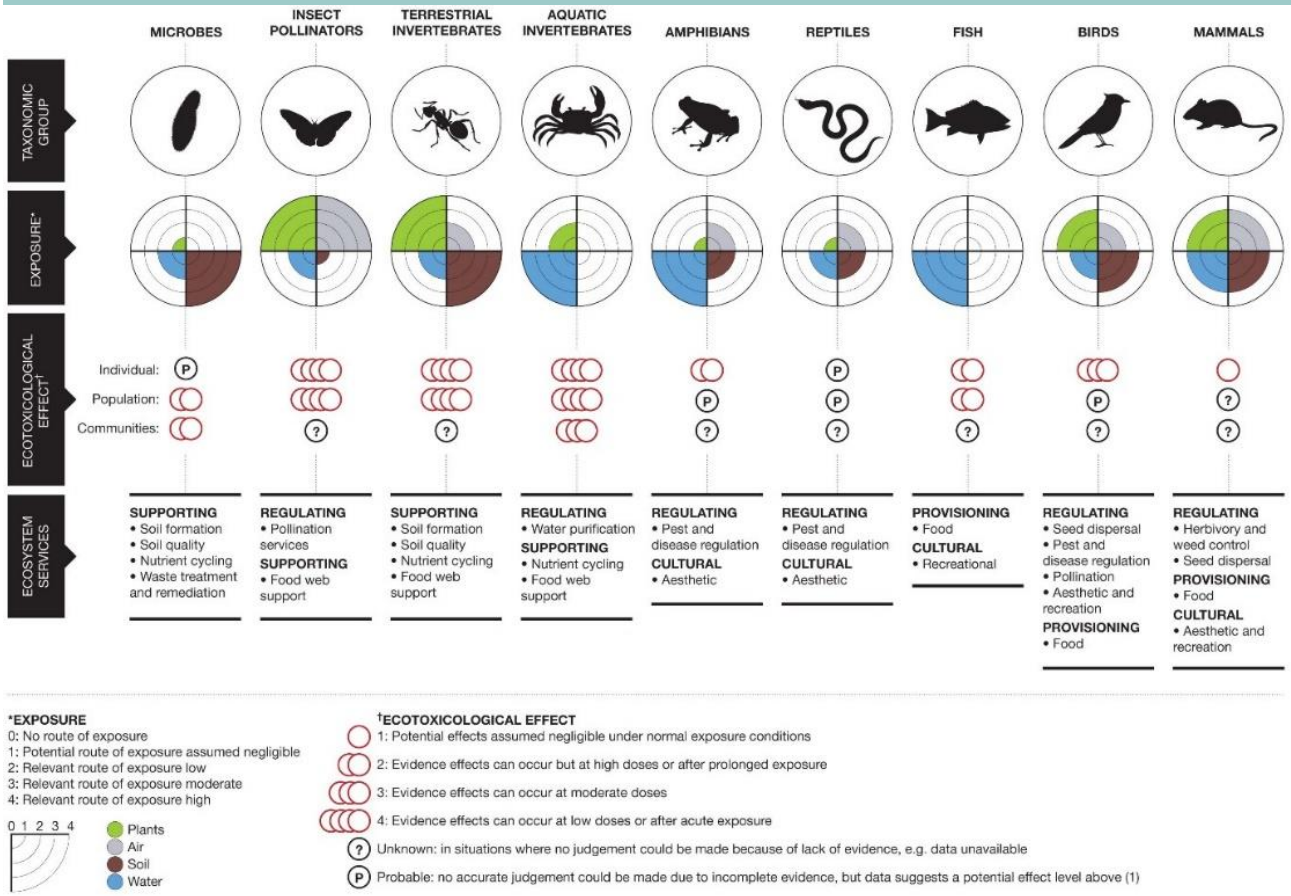
- **lack of floral resources,**
- **the presence of pesticides, especially neonicotinoids,**
- **the pyrethroid family,**
- **the presence of pathogenic parasites.**

I would also like to stress that it is indeed neonicotinoids that promote the appearance and development of parasites and pathogens in pollinators. So to all those who claim that "they are diseases, they are parasites of the varroa type that decimate pollinators", I remind them that the proof has been shown: in the presence of pesticides and in particular neonicotinoids, these

diseases and these parasites develop more and obviously lead to the decline of pollinator colonies.

What applies to pollinators also applies to other systems. For scientists, it is understood and agreed: **only a small part of the neonicotinoids go up into plants to protect them from pests. The vast majority remains in the ground**. There is very significant and persistent contamination. Then **these molecules are leached, and end up in surface water, where they can impact aquatic invertebrates.** As my colleague said, pollinators are just the tip of the iceberg. In fact, the exposure of a whole series of soil and aquatic invertebrates worries us more, especially since the life span of these molecules is very long. **Some can contaminate the environment up to 30 years.** So a systematic use of these molecules every year, or even twice a year, will obviously contaminate the soil consistently.

Degrees of exposure and respective toxicity of systemic pesticides to different categories of non-target organisms: the last row of the table details the ecosystem services provided by each family of organisms, provided free of charge and threatened by the use of pesticides.



The diagram (above) summarises all of our results. Of the diversity of species that make up biodiversity, **pollinators are most impacted by neonicotinoids** (four red pellets). But what we discover on this chart is that **the impact is greatest at the level of individuals, populations and communities, not only for pollinators, but also for soil invertebrates and all aquatic invertebrates.** It should be remembered that terrestrial and aquatic invertebrates are at the base of the food chain, and the work of researchers Kroon and Hallmann shows that we are capable of measuring

the effects of the decline of these invertebrates. Then, to a lesser extent, there are also impacts on amphibians and reptiles. But that is not all, and I would like to stress this: there are significant impacts on vertebrates, whether at the level of individuals, populations or even communities, as we have seen in fish and common birds.

Then, we can ask ourselves the question regarding the impacts on mammals and in particular on humans. What we found for pollinators - through the many impact studies, especially on the major functions of reproduction but also of the development - also applies to humans, with exactly the same effects ... We have seen this through the studies that are available, although few in number.

Our conclusions are very simple. Neonicotinoids have five main characteristics:

- they are used heavily on the planet,
- they are used prophylactically, that is to say in a preventive way, without even knowing if they are needed,
- they have a very high toxicity for all invertebrates, and a high toxicity for vertebrates,
- they remain in soils for a long time,
- they are leached by water and contaminate deep surface waters.

There is therefore a widespread contamination of the planet by these molecules. To give you an idea of the magnitude, about 20,000 tons per year of neonicotinoids are poured on the planet, knowing that it only takes one nanogram for them to have a deadly effect on bees. 20,000 tonnes, how many nanograms are likely to act on living organisms? We are talking here about pharaminous quantities.

Our conclusions of course link neonicotinoids and the decline of pollinators, but also of terrestrial organisms and aquatic invertebrates. Moreover, **there are more and more impacts on ecosystems. It is a threat to the ecosystem services, on which agriculture and the way we feed the planet** depend. It is paradoxical: under the pretext of obtaining better productions, pesticides are used that threaten not only food security (quantity of production) but also the quality of what we consume. **It is a threat to public health. I agree with my peers: this observation is clear, there is consensus and urgent action is needed.** Although decisions were made on this in 2013, I think we need to go further. I don't do politics here, I do science. I rely on facts and there is no doubt about it. **I believe that action must be taken, either by reducing or prohibiting these pesticides, in accordance with the wishes of the States**. **In any case, integrated control techniques and organic farming should be favoured.** We urgently need to reduce the amount of neonicotinoids and systemic pesticides that are being dumped on the planet.

I would like to thank certain organisations, including the Task Force to which I belong and of which I am Vice-President, the European Union which financed part of the studies, the French government and the

National Center for Scientific Research (CNRS), as well as the entire community of scientists who have worked with me for about ten years, that is to say, sixty people on four continents and who represent nearly 23 countries.

QUESTIONS/RESPONSES

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POLLINIS

Why are neonicotinoids so widely used? Are there no effective alternatives to these insecticides that have been proven on a large scale?

→ Jean-Marc Bonmatin

In fact, neonicotinoids are used because the advice given to the agricultural world comes from the companies that sell these same neonicotinoids. Yet what I have observed, and these are facts, is that neonicotinoids do not increase agricultural productivity. **Since some were prohibited in the European community[2], agricultural production has not collapsed at all.** So their usefulness raises questions. Other experiments have been carried out in the absence of highly toxic neonicotinoid pesticides and alternatives have been found to exist. A variety of tools are effective, from landscape management and agronomic practices to parasitoid or predatory (auxiliary) organisms that can be used to protect crops. If we have to use highly toxic pesticides, this should only be done as a last resort.

There are lots of methods that work very well and have proven themselves on a large scale. I will give you an Italian example in the Friuli and Veneto regions, for the cultivation of maize, which is a very important crop in these agricultural regions. They removed neonicotinoids in 2009 and have tried other techniques. **And there is a very simple one that has given excellent results.** These studies were carried out by our Italian colleagues, members of the Task Force (cf Furlan).

Actually, they didn't treat them. They put them in conditions where pests could not settle or had difficulty settling: lengthening and diversifying of crop rotations[3] and other already known agronomic techniques. Then they set up an insurance system. Since they realized that during 30 years of studies, only 4% of maize crops were susceptible to pest attacks, it was pointless to treat 100% of the crops with highly toxic molecules. So they set up an insurance system where everyone paid a contribution: **instead of paying 40 euro per hectare for the purchase of pesticides, they paid 3.50 euro per hectare** for this insurance. That's ten times less. In case of damage, the farmer is reimbursed. This system was implemented in 2015, 2016 and is continuing this year. Here is the result in a few figures: to ensure 43,000 hectares, **he entered nearly 160,000 euros into the insurance fund and has come out with nearly 85,000 to compensate farmers who lost their crops or part of their crops.** It's very interesting because first of all it's a system **that makes money**. We can reinvest in the following years.

[2] Since the end of 2013, several neonicotinoids have been subject to a partial European moratorium: imidacloprid, clothianidin and thiamethoxam.

[3] Crop diversification and longer rotation cycles extend the time between two identical crops, thus breaking the cycle of weed and pest development.

Secondly, it is a system that does not pollute. There is no more contamination of soil, water or foodstuffs. No need to test to see if there are toxins in it that will then poison us. It is a very simple system that works in the cultivation of maize in the Italian region.

I could give you other examples in China for growing rice, or in Canada for growing wheat, corn and soybeans.... We already know of many agronomic systems that do not use pesticides, particularly these highly toxic pesticides, and which work very well. And what's interesting is that **agricultural production is not less, neither in quantity nor in output.** Better yet, the selling price of these productions is higher since the products are of better quality. Which means that for farmers, **the profits are much higher.** We have surprising figures for Canada, where we see that the incomes of farmers who do not use pesticides are three times higher than those who use pesticides conventionally.

POLLINIS

We are talking about biodiversity here, but does the use of pesticides have implications for public health?

→ Jean-Marc Bonmatin

There are at least 1,500 studies on the impacts of neonicotinoids on invertebrates. On human health, there are about fifty. This is a very surprising paradox. How is it that we have so few studies on human health? The answer lies in the hazardous assumptions made at the outset, namely that these neonicotinoids would act on insects and not at all on mammals. Yet the few studies that we do have on human health shows us that the situation is worrying. What we have observed, what we have discovered concerning the impacts on insects, and in particular on bees, also applies to mammals and therefore potentially to human health.

What we already know is that these products are carcinogenic. They interact with the thyroid, liver, and testicles in men. They are potential endocrine disrupters and affect the neurological development of children.

That's already a lot... It was recently discovered that they could be responsible for heart defects in newborns, and for a disease called anencephaly, where newborns do not have their entire brain at birth and cannot survive! Other diseases are being discovered as we go along, in particular oxidative stress which is linked to damage to DNA, therefore cancer, as well as a number of other consequences. Finally, we are discovering - and this is very recent, 2016-2017 - that the molecules that were put on the market some twenty years ago have unacceptable effects on human health.
I can give you some references, there's an article that comes out from time to time that's frightening, frankly. The use of these neonicotinoids and highly toxic pesticides in general needs to be revisited.

POLLINIS

And you, Dr. Sgolastra, what do you think about alternatives to neonicotinoids? Is it possible to establish a farming without neonicotinoid and if so, what is the best alternative?

→ Fabio Sgolastra

As regards agricultural systems that are free of neonicotinoids in Europe, I will mention the case of Italy, where we have banned certain neonicotinoids. **We can therefore compare agricultural production before and after the ban. We do not find a difference in performance.** This is the evidence that agriculture without neonicotinoids is possible...

POLLINIS

What legal and technical measures can be put in place to better evaluate the sublethal effects of pesticides?

→ Fabio Sgolastra

I think we now have several measurement tools to evaluate the sublethal effects of neonicotinoids on bees. For example, there is a method to study their impact on the orientation system of bees: it is very important that bees can find their way back from the flowers from which they collect pollen and nectar. It is important to include this point in the regulatory assessment process. Perhaps it is also necessary to evaluate the effects of pesticides on thermoregulation: for bees, for example, but not exclusively, it is very important to maintain a constant temperature in the cells. It is necessary for good development of the organisms. In my opinion, this issue needs to be included in the risk assessment process.

EXCHANGES WITH THE AUDIENCE

—

John Stuart Agnew, MEP and farmer

The explanation of why bees die from neonicotinoids has been given in an experimental context where they are inoculated with high doses... Of course, they die. [...] But what if we prohibit neonicotinoids, if we can not use them anymore? [...] If we agree to give them up, which systems should we focus on? Moving towards organic agriculture? Although there are some very good ideas, there is a gap (in research). [...] The insects are reintroduced but they in turn introduce devastating viruses into the plants. [...] Then, on productivity: can we grow plants resistant to insect attacks, killing some insects and sparing others? Should we move towards organic agriculture, genetic engineering? What is your solution to feed the world?

→ Jean-Marc Bonmatin

Regarding the first argument about the dosage, you are absolutely right. In the past, it was thought that it was the dosage that made the poison.
And this still applies to most chemical molecules. But that does not apply to endocrine disruptors and neonicotinoids, for example.

"IN THESE CASES IT'S NOT THE DOSE[4] THAT MAKES THE POISON. ON THE CONTRARY, WHAT IS CALLED THE CHRONIC EXPOSURE, THAT IS TO SAY, SMALL DOSES REPEATED OVER TIME. "
Jean-Marc Bonmatin

And in this case, we find that for neonicotinoids and a number of other very highly toxic pesticides, which act on the central nervous system, the link between dose and effects is not direct. That is to say, it is not the dose that makes the poison but more the duration of the poisoning.
The simple presence of these molecules causes waterfall effects and even if the quantities are extremely low, a drop of contaminated water at each meal will have chronic effects on the whole biology of the exposed organism. I will take another example that is much more understandable: it is not the number of cancer cells in an organ that counts, but the simple fact that there is one. If there is a cancer cell in an organ, it will multiply and you will develop cancer. It's not the number that matters, it's the mere presence.

I am not necessarily against the use of insecticides. I am simply saying that we must first apply the gentlest methods, prevent pests from developing and insecticides can be used only as a last resort that. When they are needed. Not for use on 100% of crops when it is known that only a small percentage will actually be attacked. This is the principle of action - reaction. **A crop is not treated in advance at planting time without even knowing if it will be attacked by pests.** I'll take the example of medication: it's a little bit like taking antibiotics from November to May and saying "I'm going to get a sore throat or a little something in the winter". No, we only take antibiotics when we need to take them. For insecticides, it's the same thing.

[4] Namely, the quantity ingested at one time

Next, some answers about all the alternatives that exist. Take the example of rice growing in several Asian countries. They made statistics and realised that by reintroducing the natural predators and parasitoids that exist for rice cultivation, biodiversity develops in rice fields and rice production yields do not decrease. They are even better in the absence of pesticides. Figures and statistics speak for themselves. These are facts, concrete measures and not beliefs.

It's interesting because we realize that ecosystems* manage to balance themselves. Of course, it's a little more work [...]: you have to keep watch. But we can see - and this is the example of Asian countries - that productivity is identical if we let nature do its job a little, if we use varieties that are naturally resistant to insects and if we use agronomic practices that limit pest development. This is part of the answer.

"REMEMBER THAT NEONICOTINOIDS ARE NOT LIKE OTHER INSECTICIDES. THEY ACT ON THE CENTRAL NERVOUS SYSTEM AND IT'S NOT THE DOSE THAT MAKES THEM POISONOUS. WHAT'S TRUE FOR INSECTS IS ALSO TRUE FOR MAMMALS. " Jean-Marc Bonmatin

A member of a European sugar beet confederation

Mr. Bonmatin, according to you, it is not the dose that is poisonous. If this is the case, how do you explain that 90 days after beet sowing, the persistence is so high that aphids can settle again? The goal being, when sowing beets, that the seedling be protected for the first sixty to eighty days of its life, when it is most vulnerable. You gave an example for maize, but what are the alternatives for sugar beets in this area? In the absence of seed treatment, two to three or even four treatments should be controlled, without combating beet yellows transmitted by aphids...

→ Jean-Marc Bonmatin

I am not an agronomist, I don't know about all crops. However, I know that in France, ANSES (National Agency for Food Safety, Environment and Labor) is interested in alternatives to neonicotinoids since neonicotinoids will be banned from September 2018. It has also given results for vines. I am waiting for the report from the agricultural experts, to see what France proposes as alternatives, on a culture-by-culture basis, let the experts do it and see what they propose.
Nevertheless, I would like to respond to one point: you have seen aphid attacks on sugar beets despite the treatments, and here I would like to highlight this paradox. We used neonicotinoids against pests, ensuring that beneficial species would not be affected. In fact, we are seeing 20 years after, **pests continue to grow, because they have become resistance machines**. While beneficial species pay a high price for this widespread use.

If we take a closer look at pest resistance - and we are publishing a third article listing all the resistance observed - we realise that it develops very, very quickly, in a few years. The only solution agronomists have found is to use increasingly high doses and mix insecticides to broaden their action spectra by using potential synergies between two different neonicotinoids. This is a patent registered by Bayer and it is well-known: **it's a real arms race against increasingly resistant pests**. The question is simple: do we continue the arms race, knowing it is lost in

advance anyway, since pests are resistance machines? And knowing that we also have collateral damage that is becoming unacceptable to the surrounding biodiversity as a whole? Or should we question the agricultural model a little, looking at alternatives?

"AGAIN, IF INSECTICIDES ARE TO BE USED, IT SHOULD ONLY BE A LAST RESORT. DESPITE THE OPPOSITION, I URGE YOU TO REFLECT ON THIS. " Jean-Marc Bonmatin

Jean-Paul Denanot, MEP (S & D group)

I would like to sincerely thank this panel of scientists for their objective and lucid presentation, representing a broad convergence. It seems to me that today we have a duty to think about a new agriculture at a political level. This new agriculture must indeed be closer to nature, closer to the natural phenomena that have so far allowed the world to feed itself. I believe we are in a position to propose something else. The presentations you made earlier show that quite clearly. There is one question that concerns me: that is the economic question, because farmers, producers, must be able to make a living from their production. **The (Italian) example you gave seems very interesting to me, and could perhaps be integrated into a future common agricultural policy that would allow agriculture to take more economic risks to move towards better, more natural production.** I think that there is a real avenue for reflection that would allow us to go faster and further in an agro-ecology that I believe many are calling for.

Martin Dermin from the NGO Pesticides Action Network Europe (PAN)

One difficulty I see in the farming community is this reflex to ask, when talking about banning substances, what other substances do we have? This is a big problem because there are not many new insecticides on the market. Very often, they also have their own toxicity. [...] Very often, pests quickly develop resistance. **We therefore advocate a complete change in practices, and encourage the transition to integrated crop protection.** It's not just margin changes, [...] but a real change in practice. For example, the issue of sugar beet and monocultures in general always comes up in the debate on neonicotinoids [...]. There are problems because there are resistances that appear in the pests, but the real problem is that beet growing is a huge monoculture, where there is no room for ladybirds. We need woods, spaces where natural predators develop [...]. We need to change practices and restore nature in agricultural landscapes. We need a system that leaves room for natural habitats in the landscape [...]. You mentioned, sir, the beet confederation representative, that there was no resistance among aphids. But that's not true. In Australia, aphids are already resistant to the neonicotinoids used on sugar beets. These resistances are developing and arriving in Europe. Also, we have to move forward and we cannot keep the neonicotinoids. [...]. As with GMO crops, they also develop resistance. **We must change the system and return to agricultural practices that put natural areas back at the heart of the landscape.**

A representative of the Dow AgroSciences society

I work for Dow AgroSciences, which produces sulfoxaflor, which has been mentioned several times today. First of all, we consider that sulfoxaflor is not a neonicotinoid from a chemical point of view, because of the structure of the molecule [...]. I think the key question about sulfoxaflor is not whether it's a neonicotinoid or not, but what its profile is, what the risk is to bees and other insects. There are two key characteristics to be taken into account: firstly, it has a very low persistence in the environment; this has been confirmed by EFSA. Second, the remaining metabolites are not toxic. In fact, the substance has a very fast action. That's why the risk is managed and that's why ANSES authorises the product. [...]. We and every farmer should opt for an IPM (Integrated Crop Protection) system. Resistance is the main challenge. This is very important because nature is constantly evolving. How can we use all the tools we have at our disposal, at the right time and in a safe manner, in order to maintain agriculture as sustainable as possible, without losing any of the advantages of pesticides?

→ Jean-Marc Bonmatin

Indeed, differences can be highlighted between sulfoxaflor and some other neonicotinoids. But when you look at the bigger picture, especially what this molecule targets, it's still the central nervous system, the nicotinic acetylcholine receptors.

Whether it's one sub-unit or another interacting, we don't know much more than that... Besides, from my point of view, we wouldn't have all these problems with neonicotinoids - and here I'm not talking about sulfoxaflor since it wasn't on the market - if random hypotheses hadn't been made at the time of their registrations, by claiming that anyway, it is a product that is applied to the seed, and that the bees can never be exposed since they forage on the flowers and not the soil. These hazardous hypotheses have led to the current situation: it took some twenty years, hundreds of laboratories and thousands of studies to prove that they had been hazardous and proved false...

To hear today that sulfoxaflor is not the same as the others, that it is much better, that its lifespan is much shorter, that there is no toxic metabolic... That's exactly what I heard 20 years ago about neonicotinoids. We have to stop believing in risky assumptions and wait for proven facts. If the registration papers demonstrated that the molecules were non-toxic, had a short lifespan and had no effects on the auxiliaries and other organisms that provide valuable services, then why not?

But I'm not sure that the current registration rules can demonstrate that. Even though Dow AgroSciences has done its own studies, I am not sure that enough research has been done to be sure that this molecule (sulfoxaflor) will be significantly different from the others.
In any case, looking at its structure, and where it acts, I do not see any difference so fundamental as that. This remains a molecule that belongs to the class of neonicotinoids, despite some peculiarities. So there is no convincing argument for using sulfoxaflor as an alternative to neonicotinoids, in my opinion.

Lorine Azoulai, Agriculture Project Manager at POLLINIS

Let us return to the question of alternatives: the main threat when we talk about alternatives is to think "alternative = substitute molecule". What about agronomic alternatives? Namely: diversification of rotations, seed selection strategies, biocontrol strategies and establishment of agroecological infrastructures, among others. The same goes for organisational alternatives. Mr. Bonmatin, you talked about the farmers' mutual fund system, which I find very interesting. Have any of you carried out cost-benefit analyses of the implementation of these organisational or agronomic alternatives? It would also demonstrate the economic value of rethinking the agricultural system as a whole in a systemic way. My second question concerns the search for alternatives: what is the share of funding allocated respectively to the search for chemical and non-chemical alternatives in public research? This is an important question: if we do not have funding, for the search for non-chemical alternatives, excluding alternative molecules, it seems less likely that we will find them soon.

→ Jean-Marc Bonmatin

For the cost-benefit analysis of the alternatives, we do not have the figures for all crops but with regard to the Italian experiment on maize, for which we have the best data after several decades of work, I have the figures in front of me: if you use neonicotinoids, it's 40 euro per hectare. If you use integrated pest management and mutual funds, it costs you 14 euro per hectare, including damage, all inclusive. It's the societal cost. And if you only go through monitoring and integrated pest management, it's 19 euro per hectare, and if you only do insurance, then it costs 25 euro per hectare, damage included.

So we can see that **whatever the solution, it's always cheaper than using neonicotinoids**. That's part of the answer, but there are other studies that have been done for other cultures, of course. This example simply seems extremely telling to me. And it introduces a new model: is it necessary that 100% of surfaces are free of pests?

We can afford to have a small proportion of the crops affected by pests provided there is a compensatory system for farmers.

This even goes in the direction of increasing their income: not affecting agricultural productivity but making them better off. As a citizen, and this is no longer the scientist speaking at all, I am well aware that the agricultural world is suffering enormously these days and perhaps it is suffering from a system that has run out of steam. I think it's everyone's responsibility to do something, to make it better. And I wonder if it is not one of these paths that should be favoured.

A representative of the BeeLife association for European coordination

I would like to make a work proposal that perhaps we should consider. We are talking about the agricultural model, but it is a whole sector that we must review, and the first thing is the place of pesticides and their marketing authorisation. So far, normally, there is a logic to testing pesticides introduced on the market to make sure that everything goes well, but we don't attach much importance to the quantity used, etc. And the main problem comes from the fact that they are widely used this is the case of neonicotinoids but also of other products [...]. Perhaps we could get out of the established patterns and change the regulations. If the problem is the massive use

of high-risk products, would it be possible for us to establish a framework defining maximum limits for the use of products?
Also, farmers who use these products do so very badly, perhaps because they do not know how to use them properly.

A representative of the BirdLife association

Just a quick comment: we also have legislation on the sustainable use of pesticides in the EU that should be considered for implementation. I would like to hear back from the speakers on this point.

A member of Greenpeace

I have two very specific questions about environmental regulation. I address the first one to Dr. Sgolastra, who mentioned the need to maintain a risk assessment with updated data. You have done some very interesting studies on the combined effects of fungicides and insecticides: do you think that these two types of pesticides are sufficiently present together to justify a risk assessment, for all pesticides and their possible synergistic effects? My second question is for Professor de Kroon: the committee has proposed a partial ban on neonicotinoids and an almost total ban on three of them, with the exception of one greenhouse use. Do you think that your results prove that the use in greenhouses remains problematic and how do you react to this proposal?

→ Fabio Sgolastra

Of course, from a regulatory point of view, it is impossible to test every combination with every pesticide because there are too many chemicals. But I think there are potential synergies that could be incorporated into the regulatory assessment process. And especially for fungicides (...), which can be used regularly in the fields during flowering without problems, but necessarily interact with the neonicotinoids, which are spread uninterrupted via the sap of the plant. Even if neonicotinoids were to be used as crop sprays, this could be an even bigger problem for bees.

→ Hans de Kroon

With regard to greenhouses, I am not convinced by the proposed regulations. What happened in the Netherlands is that the government - probably under the auspices of water management services - forced the greenhouses to filter their wastewater, which until recently joined the network, leading to a peak concentration of imidacloprid. Since the measure was taken into account only a few years ago, I cannot comment on its effectiveness.

A FEW WORDS TO CONCLUDE

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NICOLAS LAARMAN

General Delegate of POLLINIS

I would like to come back to the issue of resistance, which has been raised several times in this debate. Without venturing into technical issues, I would like to mention the very worrying consequences in the short and medium term for citizens. In the background of all the studies that have been mentioned today, there is the idea that our agriculture is facing a technical and economic impasse for which we are obviously not prepared, or at least poorly prepared.

"WITHOUT A RAPID REORIENTATION OF PUBLIC POLICIES TOWARDS A TRULY SUSTAINABLE NEW AGRICULTURAL MODEL, THE FOOD SYSTEM FOR WHICH WE HAVE SACRIFICED OUR ENVIRONMENT AND HEALTH IS UNLIKELY TO FEED THE WORLD, OR EVEN EUROPE, IN DECADES TO COME. " Nicolas Laarman

A figure seems to me fundamental to illustrate what is at work in our fields: in equal doses**Imidacloprid is 7,300 times more toxic to bees than DDT, which was banned in the late 1970s.** How can such a race for toxicity be explained? What has changed since the 1970s that would justify today such toxicity of the products spread in the fields and thus force farmers to undermine the very life on which their cropping systems are based, the quality and quantity of crops they can hope to produce? The agrochemical industry always highlights its capacity for innovation to justify the replacement of an active substance by a new molecule, generally more toxic. This change is most often explained by the mechanics of resistance phenomena in organisms targeted by pesticides. This mechanism is inescapable: it is the result of the natural adaptation of organisms to external pressures. But it is reinforced and artificially multiplied by the consumption of pesticides: the intensification and systematisation of this consumption leads pest organisms to become "super-resistant" - just as the repeated use of antibiotics has contributed to the emergence of resistant super bacteria which today threaten our health.

Faced with these alarming problems, the response of industrialists and professionals in intensive agriculture is to use increasingly toxic molecules, reinforcing resistance phenomena and the adaptation of bio-aggressors to new products. Many cases of crop pest spread, which have become resistant to chemical treatments, are already warning us. The spread of amaranth, a "weed" resistant to Roundup sprays, has recently led to the abandonment of thousands of hectares of Roundup Ready GM soybean crops in the US, and is now a problem for all US soybean crops. The FAO (The Food and Agriculture Organisation of the United Nations) and the scientific community have recently expressed concern about outbreaks of new resistant varieties of wheat rust, the wind-borne fungus that destroys whole wheat crops in Europe, Africa and Asia,

transforming them "into piles of yellow leaves, black stems and flattened grains". In 2016, the rust epidemic fell on thousands of hectares in Sicily: modern wheat varieties, selected for decades to meet the standards of the agro-industry, have not kept up with the new resistant strains of the disease. Many other countries have observed the appearance of rust varieties in their fields in recent years that they have never seen before.

Wheat is a major food source in Europe and a livelihood for more than one billion people in developing countries: in North and East Africa, the Near East, central and southern Asia, the areas most vulnerable to this new form of the disease. According to the FAO, nearly 37% of world wheat production is at risk. We're facing an emergency!

"THE TOXIC SPIRAL TRIGGERED BY THE MASSIVE USE OF PESTICIDES IS TAKING AGRICULTURE TO A DEAD END AND THREATENING OUR COLLECTIVE ABILITY TO PRODUCE FOOD. THE SYSTEM, BASED ON THE ASSUMPTION OF UNLIMITED ACCESS TO CHEMICAL SOLUTIONS TO ELIMINATE ALL INSECTS, WEEDS AND UNWANTED FUNGI FROM THE FIELD, IS THREATENING TO COLLAPSE. AGROCHEMISTS AND CROP PROTECTION EXPERTS THEMSELVES BELIEVE THAT THERE IS A SERIOUS RISK THAT THERE WILL SOON BE NO CHEMICAL BULWARK AGAINST THE GROWING NUMBER OF RESISTANT PESTS. " Nicolas Laarman

Beyond a prohibition of neonicotinoids, **we call for a change of agricultural paradigm, and a new CAP, adapted to support the transition towards new agronomic and organisational models** : a reorientation of public research in favour of non-chemical, agronomic and organisational alternatives, the creation of a transition fund intended to support and accompany farmers in changing their production techniques, the reallocation of aid in favour of alternatives. The European food system is more the result of policy choices in public research, regulation and customs barriers, subsidies and support for farmers and agribusiness actors than competition or market forces, as we hear all too often.

All these policies and regulations are made on behalf of citizens, in their interest, to feed them. The key phrase at first was: *"We have to feed the Europeans"*. Then, faced with the success of this new model of agriculture, intensive in inputs and subsidies, which produced to excess, it was necessary to "feed the world". It is this apparently noble objective that has been opposed whenever we citizens, faced with the harmful effects of pesticides on the environment and our health, call upon political representatives to hold them to account. They answer us as follows: *"Yes, we suspect that insecticides have an effect on insects, but we have this responsibility, this priority objective: we must feed the planet"*.

"TODAY, WE, EUROPEAN CITIZENS, ARE ENTITLED TO DOUBT THE REALITY OF THIS COMMITMENT FOR THE FUTURE. WE CAN ADOPT AN AGRICULTURE THAT PRODUCES WITHOUT CHEMICAL CRUTCHES AND THAT FEEDS. THE WORK CARRIED OUT IN ITALY, AND MANY OTHER EXAMPLES IN EUROPE AND THROUGHOUT THE WORLD, ARE EVIDENCE OF THIS. WE THINK IT'S TIME TO MOVE UP A GEAR. AND IT IS PRECISELY TO FEED THE WORLD TODAY AND TOMORROW THAT WE MUST CHANGE THE WAY WE PRODUCE AS QUICKLY AS POSSIBLE. "
Nicolas Laarman

ÉRIC ANDRIEU

MEP, spokesperson of the European Social Democrats for Agriculture and Rural Development in the European Parliament

First of all, I would like to thank all of you for your attendance and participation, and of course thank the NGO POLLINIS. It is absolutely without regret - I say this emphatically at the end of our exchanges and this conference - that I sponsored this event, as the exchanges were rich and the presentations fruitful. I also thank my team for allowing this to run smoothly.

I had written a conclusion, but I am not going to give it any thought in terms of the content of the subject, because the discussion and exchanges that have taken place, both scientific and technical, raise questions about how much politics is involved. I would like to answer that question. The issue that was discussed this morning is eminently political, and I think that we are here at a time when we will have to assume our responsibilities. The debate is going to be productive, since Mr Agnew, who spoke earlier, and I have opposing positions on the issues that animate us - and that's the strength of democracy. When we ask ourselves the questions of a democratic debate, it is already a first step towards the answer.

And actually, **I think that on the question of the agricultural model, in 54 years of the common agricultural policy, we have asked ourselves too little the question or questions of the agricultural SENS.** And I am one of those who think that we need to take agriculture out of its sectoral vision and give it a more systemic dimension. In other words, in our economy in the societal sense of the term, agriculture is in politics. And in geopolitics, agriculture has lost its place at the heart of the society in which we live today, because we have restricted it to a sectoral or "mono-something" approach... I think that today's debate, which we are currently engaged in and which must be addressed, is precisely the meaning of an agricultural policy and even beyond, the meaning of a **public** agricultural policy. This is two different things. As we begin to discuss the future reform of the Common Agricultural Policy, I believe that the very meaning is being questioned. **Is the link between agriculture, food and human health now established?**

This is a debate that we need to have, between representatives of the citizens, of the 600 million European citizens. Is the link between food, agriculture and the environment, in the sense of common goods, being established and questioning us? Changes, whether we like it or not, will be imposed on us with an extraordinary speed. This is disproportionate to what we have

experienced over the past thirty years, both in terms of climate change, technological change and geopolitical relations.

The climatic factor forces us today to move faster and to accelerate reflection on the question of the agricultural model.

Beyond climate, there is technical and scientific data. I am a fervent defender of new technologies, but the prerequisite I ask in my reflection as an elected official is knowing what to serve **Is science at the service of human health, of employment, of territories, or at the service of sectors, therefore of financialisation and structures that pass through tax havens, etc.?** These are two alternatives that we must study and have the courage to debate. **The question of technology will be raised and will, I believe and hope, be at the heart of the debate on the future common agricultural policy.**

And the third factor that also seems to me to be an accelerating factor: geopolitics. **We can no longer imagine that Community policies within the European Union, concerning agriculture, are built within ourselves.** Today, we cannot imagine European policies without looking at what is happening in China, in food security in particular, but also what is happening in India, Brazil, the United States...

Today, I think we must have the courage to ask all these questions and have a political input in the societal sense for the agricultural model that we are concerned with. It is not by substituting - to return to the subject of neonicotinoids - one molecule for another that we will answer these societal questions. I say it again to those who think that, if we are to give agriculture a place in our societies again, **it is not necessary to have minimal reforms, but major reforms on the** Common Agricultural Policy. If we are to make progress in this sector, this will require genuine political courage and the determination of broad guidelines.

As soon as we commit ourselves to work on the issues of human health, territorial balance, employment and environmental protection, we will not be able to obtain results through superficial, minimal changes. Today, we are in a research field: we met an EFSA team two weeks ago with a small delegation. They themselves tell us: we are in a research phase for GMOs. But there is a huge gap between research and action. I believe that we must avoid playing sorcerer's apprentices collectively, at the risk of putting the planet and the human health of Europe's 600 million citizens at risk.
What is true for GMO research is also true for international trade. We are in the middle of a debate today on the question of trade and balance. Before we talk about international trade, I think we need to have a political vision of the situation at Community level. Then we can debate with the other continents. Without this, agriculture will remain the adjustment value in the agreements we are negotiating, whether with Mercosour [Southern Common Market / Spanish Mercado Común del Sur], Canada, Australia or New Zealand. If we are not careful, these agreements could result in the desertification of entire areas of our rural areas and the undermining of our agriculture.

I appeal for reflection and political responsibility. We should decide on a ranking in our questions and not invert the direction of the pyramid. If human health is at the top of the pyramid, let us adjust our thinking towards it. That is my commitment in coming here to this assembly.

In any case, I thank you for the strength and richness of our exchanges and I hope that they will have enabled everyone to appreciate what is at stake.

"THE QUESTION OF NEONICOTINOIDS AND PESTICIDES IN GENERAL MUST BE AT THE HEART OF THE ISSUES THAT CONCERN US TODAY AND TOMORROW. " Éric Andrieu

MEP Éric Andrieu called for the total ban of neonicotinoids and a change in agricultural models. In the background, Nicolas Laarman, general delegate of POLLINIS and researchers Caspar Hallmann and Peter Neumann. In the front row, Dr. Jean-Marc Bonmatin.

INTERVIEWS

In the run-up to the conference, the POLLINIS team interviewed the speakers. All of these interviews are available on www.pollinis.org

PROFESSEUR HANS DE KROON & CASPAR HALLMANN

→ We followed the evolution of the total biomass of flying insects. The entomological society of Krefeld used "Malaise traps": the insects fly on the site, and finally find themselves trapped in a bottle of alcohol. Every 10 days, we empty the bottles and we replace them. Their contents are filtered and weighed.

→ This procedure has been followed for 27 years in different nature reserves in Germany[5]. Over the years, we have noticed that the samples have been reduced as the bottles have become emptier.

→ The most likely explanation is that these small reserves, representative of European natural areas, are surrounded on all sides by agricultural areas. Although they appear very green, these landscapes are hostile to insects: they cannot ensure their life cycle (feeding, growth, reproduction...) and they cannot spend the winter there. Worse, in most cases, they are poisoned.

→ We must consider expanding our nature reserves, creating buffer zones around areas hostile to insects.

→ Another thing we can do is to restore part of the landscape, so that insects have places with fewer pesticides - where to nest, feed and reproduce - to complete their life cycle in a viable environment, healthy soil, clear water and plants where they can spend the winter.

[5] Several sites were studied: Natura 2000 (37 sites), Nature reserves (7), Protected natural areas (with conservation measures, 9 sites), Water protection zones (6), Natural habitat zones protected by regional associations (4).

PROFESSOR PETER NEUMANN

→ The massive use of pesticides can pose a danger to our safety, because insects and other invertebrates are essential to the proper functioning of ecosystems. It is therefore a question of defending these ecosystems.

→ Pollination is an example of a key ecosystem service. But there are other services, such as those provided by soil organisms, that play a vital role in land fertility.

→ There is also natural pest control through insects, spiders, birds and invertebrates that eat pests. The situation is critical: our food security is in danger.

→ An alternative to neonicotinoids? Personally, I think we can set the neonicotinoids aside. Firstly because they are used in a prophylactic way, i.e. farmers make systematic use of them, whether pests are present in crops or not... This brings us to integrated crop protection that [...] only uses chemical treatments as a last resort. Second, neonicotinoids do not have a specific action: they impact everything. So I take into consideration the effects on non-target species.

→ **To protect pollinators, pesticide use practices must be reviewed. Crops should be tested on a case-by-case basis in order to adapt farming practices.**

DOCTOR JEAN-MARC BONMATIN

→ The neonicotinoid problem is even more serious than we originally suspected. They contaminate all compartments of the environment and these toxic molecules impact all terrestrial and aquatic invertebrates, but also vertebrates.

→ I refer in particular to the cascading effects on birds and fish. The massive use of these molecules pushed the resistance of insect pests, while they had extremely harmful effects on all beneficial insects. We have reached a paradoxical situation, where finally we can no longer get rid of pests that become resistant to neonicotinoids. We are forced to increase the doses, to use them in mixtures, while auxiliary insects, beneficial to agriculture, are increasingly impacted.

→ It has been found that, in most cases, these chemical molecules are useless for crop protection. Very few crops are actually attacked by pests. And it is enough to put proven agronomic techniques in place to ensure that insect pests do not spread. I am thinking in particular of crop rotation or, if insects are present, we can use pesticides of lesser toxicity, natural pesticides for example, which will solve the problem in a targeted manner in contaminated parts of the crops.

→ These pest resistance problems are crucial. It was also found that there were unexpected effects on some pests. For some flies, for example, the presence of neonicotinoids has increased fertility, and there are more pests than at first.

→ Insecticides should not be used automatically. If they are allowed, they should only be used as a last resort when all the other techniques, much more sustainable or biological, have been implemented without success. First of all, all organic farming and integrated pest management techniques must be favoured.

PROFESSOR FABIO SGOLASTRA

→ A synergistic effect between two or more molecules is when their combined effect is greater than the sum of their individual effects. The synergistic effect - or cocktail effect - is one of the possible results of the interaction between several molecules.

→ Another effect, more traditional, is the additive effect, where 1+1 = 2. On the other hand, in the case of the synergistic effect, 1+1 is not equal to 2 but to 3, 4 or 1000. The studies we have done so far, focused on apoidal insects[6], have shown that synergistic effects can seriously affect their lifespan, especially in solitary bees. This decrease in longevity corresponds to a decrease in fertility: a solitary female bee that lives only 10 days because of the interaction between different chemicals in the environment will produce half or less of its normal offspring. In terms of population dynamics, this impact is very important.

→ The main substances that may interact in the agricultural environment are in particular neonicotinoid insecticides and fungicides, especially those that inhibit sterol biosynthesis. These fungicides interfere with the detoxification system of bees, making them more vulnerable to other pesticides, particularly neonicotinoid insecticides.

→ **The assessment of the synergistic and sublethal effects of pesticides on pollinating insects should absolutely be introduced into the European procedures, which are currently limited to the analysis of the direct mortality rate of insects**, i.e. the observation of the death of the bee following direct exposure to the product. Obviously, this is not enough, because sublethal effects can have repercussions on population dynamics as well as on the survival of the super organism: the hive. For example, if bees, disoriented because of exposure to chemical substances, can no longer find their hive, they die, and deprive their hive of the pollen collected. **Exposure to sublethal doses ultimately has a lethal effect, both on individuals and on insect communities**.

→ Standard protocols for risk assessment should be studied or refined. At the moment, "ring tests" are being conducted, international tests for the standardisation of these protocols. On this part, we see progress. If before, pesticide risk assessment for bees **was limited to acute, oral and contact exposure,** today we have a protocol, developed by the OECD, to evaluate **the effects of chronic exposure on adult individuals and on larvae**. In addition, research groups are working

[6] The apoids belong to a family of insects of the Hymenopteraorder which includes wasps and bees.

on the establishment of standard protocols, to be submitted to the OECD, to assess the sublethal effects of the loss of orientation.

→ Synergies between the active substance and other co-formulants in a marketed pesticide product should also be analysed in more detail. We have studies that show the harmful impact of some co-formulants separately. The effects of their interactions with the active substance should therefore be investigated even more.

ÉRIC ANDRIEU

→ I hope that the European Commission will assume its responsibilities. I believe that the debate is ongoing and that this type of event will encourage clear proposals to prohibit neonicotinoids, as we have seen in France, and in accordance with the precautionary principle

→ I believe that we must stop this policy of sorcerer's apprentices where we put molecules on the market without any guarantee that there will be no impact on the environment, human health and our common goods.

Before the European Parliament in Brussels, the POLLINIS team alongside researchers Caspar Hallmann, Jean-Marc Bonmartin, Fabio Sgolastra and Hans de Kroon after the conference organised by the NGO on 7 November 2017.

POLLINIS would like to thank MEP Éric Andrieu and his team for sponsoring this conference, as well as Hans de Kroon, Caspar Hallmann, Peter Neumann, Fabio Sgolastra and Jean-Marc Bonmatin who have agreed to present their research results on the impacts of neonicotinoids on ecosystems to the European Parliament.

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