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BACKGROUNDER

Neonicotinoids : a threat for the food security

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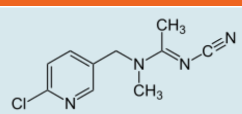
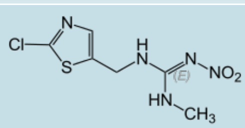
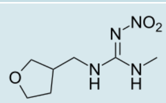
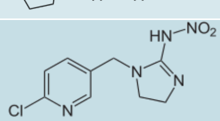
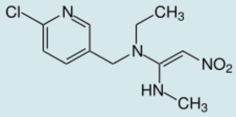
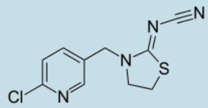
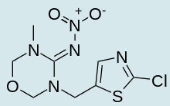
BACKGROUNDER : NEONICOTINOIDS: A THREAT TO FOOD SECURITY

Neonicotinoids: sales and uses around the world

Neonicotinoids, also known as "neonics," are synthetic nicotine analogues with insecticidal properties (Table 1). Introduced into the market between 1991 and 2002,[1] they were created specifically to thwart the resistance developed by insect pests to previous generations of insecticides (organophosphates, carbarmates and pyrethroids).[2] In just two decades, neonicotinoids have risen to the top of the global insecticide market,[3, 4] accounting for 23.7% of sales.[3] Currently registered for veterinary and phytosanitary uses in over 120 countries,[3] these insecticides are above all used in agriculture — and often prophylactically — on such crops as corn, soya, canola, grains, cotton and sugar beets.[2, 3, 5] Pest control measures take the form of soil treatment, foliar application and seed coatings.[2, 3] Veterinary treatments, in turn, includes tablets administered orally and topical products[6] (liquids and collars).

Table 1: Neonicotinoids currently available on the global market[1, 3, 7]

Active ingredient	Molecular structure	Manufacturer	Market entry	Usage
Acetamiprid		Nippon Soda	1995	Phytosanitary
Clothianidin		Sumitomo Chemical Takeda Agro Co. + Bayer CropScience	2000	Phytosanitary
Dinotefuran		Mitsui Chemicals	2002	Phytosanitary
Imidacloprid		Bayer CropScience	1991	Phytosanitary Veterinary

Nitenpyram		Sumitomo Chemical Takeda Agro Co.	1995	Veterinary Phytosanitary
Thiacloprid		Bayer CropScience	2000	Phytosanitary
Thiamethoxam		Syngenta (Novartis)	1998	Phytosanitary

Neonicotinoid use in Canada

In Canada, all currently existing neonicotinoids are registered, with the exception of dinotefuran.[8] Nitenpyram is used exclusively in veterinary contexts, chiefly in the form of oral tablets to treat flea infestations in cats and dogs.[9] Furthermore, Canada authorizes the use of 145 end-use products containing neonicotinoids (Table 2), dominated by products containing imidacloprid.[10] In Québec, while it is difficult to determine the total number of end-use products containing neonicotinoids, 55 are used on economically important crops.[11] Overall, seed treatments account for a large percentage of these products, as in Québec, where they represent 52.7% (calculation based on the pesticides used for economically important crops in the province).[12]

Table 2: Number of end-use products containing neonicotinoids currently registered in Canada[10]

Active ingredient	Total number of products registered in Canada
Acetamiprid	7
Clothianidin	16
Imidacloprid	97
Thiacloprid	2
Thiamethoxam	23
TOTAL[a]	144

a: One product (Sepresto 75 WS) contains both clothianidin and imidacloprid. Though taken into account in the number of products based on each active ingredient, it was tallied only once in the "TOTAL" line.

Table 3 shows the neonicotinoid quantities sold in Canada in 2014. In this class of insecticides, clothianidin — a substance that placed tenth among the country's top-selling active ingredients for that year[13] — accounted for the lion's share of sales. However, Health Canada's use of broad quantity intervals in reporting pesticide sales seriously undermines the accuracy of these findings. What's more, these data only partially reflect the quantities actually used, since the federal government does not monitor coated seed sales.[14, 15] The situation is the same in Québec, where the neonicotinoids used on seeds treated outside the province are not accounted for in the provincial pesticide sales report.[16] Insecticide-coated seeds are used on 500,000 hectares of cropland in Québec — close to 30% of the province's total field crop area — but only 5% of these seeds are treated in Québec.[16]

Table 3: Quantities of neonicotinoids sold in Canada in 2014[11]

Active ingredient	Quantities sold (kg of active ingredients)
Acetamiprid	< 50,000
Clothianidin	> 100,000

Imidacloprid	> 50,000
Thiacloprid	< 50,000
Thiamethoxam	> 50,000

A class of insecticides popular among farmers

"From zero to hero." As this title of this article written by two Bayer CropScience researchers suggests,[4] neonicotinoidss have enjoyed impressive commercial success, particularly in agriculture. Certain distinguishing characteristics of these new insecticides appear to drive their popularity. First, their high water solubility (Table 4) ensures translocation throughout plant tissues, thus extending protection to every part of the target crop.[2, 4, 17] Second, their persistence in soil and plant tissue (due to long half-lives, Table 4) means fewer interventions are needed.[2, 17] Third, the diversity of treatments available makes for great flexibility of use and application.[2, 3] Seed coatings in particular are often considered a safer form of crop protection, since they involve lesser quantities of active ingredients than spray applications.[2, 3]

Table 4: Water solubility and environmental persistence of neonicotinoids[7]

Active ingredient	Water solubility (mg/l)	Half-life, aerobic soils (d)[a]	Half-life, plant tissue (d)[a]
Acetamiprid	2,950	3	15.4
Clothianidin	340	545	16.6
Dinotefuran	39,830	82	6.8
Imidacloprid	610	191	4.9
Nitenpyram	590,000	8	ND
Thiacloprid	184	18	3.8
Thiamethoxam	4,100	121	4.4

a: The database consulted gathers numerous data for a given parameter. The data shown here are the highest obtained from the most reliable sources.

Neonicotinoids' immense success can also be attributed to their mechanism of action, which targets nicotinic acetylcholine receptors (nAChRs). While these receptors are present in both vertebrates and invertebrates, they are more numerous in insects, whose nAChRs also exhibit greater neonicotinoid affinity.[2, 3] This selective targeting of arthropods is why neonicotinoids are considered safer than previous insecticide classes for non-targeted organisms, including humans.[18-22] However, despite the lower toxicity of neonicotinoids both toward vertebrates and compared to previous pesticides, a rising number of studies show that neonicotinoid exposure poses a potential risk to mammals, even humans[23]. Furthermore, given that nAChRs constitute a previously untapped biochemical target in the field of pest control, numerous pest species have yet to develop resistance, giving neonicotinoids an advantage in terms of efficacy.[2,4]

The Task Force on Systemic Pesticides sounds the alarm

Despite the aforementioned advantages, the use of neonicotinoids poses a significant threat to ecosystems. Alarmed by the sharp decline of arthropod populations across Europe, scientists came together in 2009 to probe the causes of this worrying phenomenon, whose beginnings could be traced back to the 1950s. They soon noted that the decline had accelerated significantly between 1990 and 2000, accompanied by a marked reduction in the populations of certain bird species until then considered 'common.' The group hypothesized that neonicotinoids and fipronil (a pesticide with similar properties), introduced into the market in the early 1990s, were among the key causes of the catastrophic decline.[24]

These observations led to the establishment of the Task Force on Systemic Pesticides, which brings together scientists from a range of disciplines (agronomy, biology, chemistry, ecotoxology, entomology, risk evaluation, toxicology and zoology) from some 15 nations on four continents.[24] In 2011, the group launched the Worldwide Integrated Assessment on Systemic Pesticides, an imposing synthesis of 1,121 peer-reviewed studies that was published in 2015 as a report[25] and as a series of eight papers in a special issue of the Springer journal Environmental Science and Pollution Research.[2, 5, 17, 24, 26-29] Regarding neonicotinoids and fipronil, the group's conclusion was as follows:

> The wide-scale use of these persistent, water-soluble chemicals is having widespread, chronic impacts upon global biodiversity and is likely to be having major negative effects on ecosystem services such as pollination that are vital to food security and sustainable development.[24]

The Task Force recently updated its assessment to take into account new data from over 500 new peer-reviewed studies.[30] The update, to be published in 2018 in Environmental Science and Pollution Research, largely backs the group's 2015 conclusions.[30]

The sections below summarize the Task Force's findings regarding the main impacts of neonicotinoid contamination of environmental compartments and the value of neonicotinoids in pest control.

Neonicotinoids in pollen, nectar and the air: pollinators under threat

Their systemic nature means that neonicotinoids spread completely through the tissues of treated plants. Consequently, they are found in the nectar and pollen of different treated plant species (Table 5), which thus become a source of exposure for pollinating insects (bees, bumblebees, leafcutter bees, butterflies, etc.).

Table 5: Presence of neonicotinoids in the nectar and pollen of treated plants

Compartment	Plant	Active ingredient	Av. conc. (ppb)[a]	Max. conc. (ppb)[a]	No. of Ref.
Nectar	Canola	Imidacloprid	ND	0.8	28
		Clothianidin	0.58	2.4	29
	Squash	Imidacloprid	10	14	30
		Thiamethoxam	11	20	30
Pollen	Canola	Imidacloprid	ND	7.6	28
	Squash	Imidacloprid	14	28	30
		Thiamethoxam	12	35	30
	Corn	Imidacloprid	2.1	ND	31
		Clothianidin	3.9	ND	32
		Thiamethoxam	1.7	ND	32
		Clothianidin	1.8	5.7	29
	Sunflower	Imidacloprid	3.0	11	31

a: ND = non determined

The fact that the neonicotinoid concentrations detected (Table 5) are low is no gauge of their safety for pollinating insects. Indeed, though some authors consider it unlikely that these concentrations can cause pollinator death, even following chronic exposure,[31-32] such concentrations can nonetheless alter the development, behaviour, orientation, memory and learning abilities of pollinating insects. (For a list of studies on the sublethal effects of neonicotinoids in pollinators, consult the literature reviews carried out by Blacquière et al, 2012[33] and Van der Sluijs et al, 2013.[22]) For example, studies have revealed negative effects on the development of bee and bumblebee larvae when their food contained doses of imidacloprid (5 to 16 ppb) at the same low level as those found in the nectar and pollen of plants treated with neonicotinoids.[34, 35] Another study reported decreased levels of activity and olfactory capacity in bees fed a sugar solution containing 24 ppb of imidacloprid,[36] a concentration that can be found in the environment (Table 5).

Another worrying phenomenon regarding pollinator health must be underscored: the irreversible affinity between imidacloprid and insect nicotinic acetylcholine receptors.[37] Like other neonicotinoids, imidacloprid mimics the action of acetylcholine when it binds to nAChRs; but unlike the neurotransmitter, imidacloprid is not degraded by acetylcholine, resulting in the irreversible blockage of postsynaptic nAChRs.[37] In this way, the dose of the exposure is less important than exposure duration, since the toxic effects are cumulative.[38, 39]

Untreated plants, particularly those growing along the edges of fields, are also a source of exposure for pollinators, since they can be contaminated at levels similar to treated plants.[40] For example, it has been well established that planting seeds coated with neonicotinoids using pneumatic seeders contaminates the air by generating exhaust that disperses with the wind; this exhaust, which contains neonicotinoids from erosion of the seed coatings, falls on and contaminates adjacent vegetation.[40, 41]

Due to their toxic effects on pollinators, neonicotinoids are today recognized as among the causes for the decline in bee and other pollinator populations in various regions worldwide.[5, 22, 30, 42-45] In Canada between 2006 and 2014, for instance, annual bee colony losses were consistently above the norm of 10% to 15%, reaching a high of 35% in winter 2007/2008[43]; This trend continued between 2015 and 2017. We should bear in mind, however, that honey bees are human-managed populations. The impact of neonicotinoids on wild pollinator populations and on all the services provided by ecosystems must therefore be examined more broadly, as the Task Force on Systemic Pesticides has done. The massive decline in pollinating insects is extremely alarming, given their vital role in plant reproduction: and when just over a third of the world's food production volume[46] and more than two-thirds of food production diversity depend on pollination, it is ultimately our food security that is under threat. [24, 27, 47, 48]. When public health researchers conducted a study to determine how people around the world might be affected by the total loss of animal pollinators, such as bees, they estimated that global fruit supplies would decrease by 23%, vegetables by 16%, and nuts and seeds by 22%. They predicted that these changes in food supplies could increase global deaths from chronic and nutrition-related diseases by 1.42 million people per year[49].

Neonicotinoids in soils: earthworms and microorganisms under threat

Neonicotinoids have also been detected in soils, where they can persist for years.[17, 50] A study conducted in France on different soils subject to varied climatic conditions and agricultural practices revealed imidacloprid concentrations in 91% of the samples analyzed.[51] While this insecticide had been detected in 100% of treated soils in the year the study was conducted (average concentration of 12 ppb), it had also been detected in 97% of treated soils one year (average concentration of 6 ppb) or two years (average concentration of 8 ppb) prior to the study. Concentrations were higher in the soils treated for two consecutive years, showing the insecticide's potential to accumulate in the ground.[51]

Still, neonicotinoid concentrations generally tend to stabilize to roughly 6 to 7 ppb within three to five years of consecutive application. This was demonstrated in an American study (corn treated with clothianidin)[52] and another in Canada (corn treated with clothianidin or thiamethoxam).[53]

The presence of neonicotinoids in soils is not without impact for soil organisms, which in turn can affect soil ecosystem processes and services. Earthworms, in particular, which play a key role in soil maintenance, aeration and biogeochemical dynamics,[54-55] are just as susceptible to neonicotinoids as the insects these products target.[56] Earthworms can come directly into contact with neonicotinoids through applied granules (soil treatment) or coated seeds,[5] be exposed to residues found in the litter of treated plants,[57] or ingest contaminated soil particles during feeding activities.[58] Neonicotinoids are among the pesticides most toxic to certain earthworm species,[49-60] the lowest median lethal concentrations (LC_{50}) reported in in the order of tenth or ppm unit.[5] While residual concentrations found in the soil are 100 to 1,000 times lower than such doses[52, 54, 61] and as a result, very unlikely to be lethal, they can still induce sublethal toxic effects in earthworms[5,24] in such areas as behaviour and reproduction.

Outside their effects on soil invertebrates, neonicotinoids can also alter the metabolisms of microorganisms[27] vital to the health and equilibrium of soil ecosystems, particularly regarding nutrient (biogeochemical) cycles.[62] Among the potential negative impacts, one study suggests that acetamiprid can inhibit respiration among soil bacteria at concentrations likely to be encountered in the environment.[63] Another shows that imidacloprid induces changes in the structure, genetic diversity and catabolic activity of soil bacterial communities.[64]

Neonicotinoids in the water: invertebrates and marine food webs at risk

Contamination of marine ecosystems occurs by leaching and runoff (fostered by neonicotinoid water solubility, regardless of mode of use) as well as atmospheric drift (through foliar applications and planting coated seeds).[5] Numerous marine invertebrates — crustaceans, amphipods and insects in particular — are thus directly exposed to neonicotinoids, and potentially for extended periods, which affects their abundance, reproduction, development, behaviour and ability to fulfil their trophic or biogeochemical functions.[5, 27] While these various effects have been linked to imidacloprid as part of extensive long-term environmental monitoring,[65] other studies have shown clothianidin and thiamethoxam to be toxic for a wide range of aquatic invertebrates.[66, 67]

In terms of the ecosystem, the negative impact of neonicotinoids on invertebrates — a critical link in the transfer of energy and nutrients between primary producers and higher trophic levels — can alter the base of the aquatic food chain.[27] Here, not only do the equilibrium and resilience dynamics of aquatic ecosystems risk being disturbed, but so do those of terrestrial ecosystems, given that numerous aquatic insects live on land during their adult life stage[27] and that many terrestrial organisms (e.g. birds, mammals) feed on aquatic invertebrates. Certain ecosystem services linked to the decomposition of organic matter and nutrient cycling may also be compromised.[27]

Faced with the risks posed by neonicotinoids, some provinces and nations have enacted control measures. This is the case in Ontario, which in 2015 enacted new regulations targeting an 80% reduction in the number of acres planted with neonicotinoid-treated corn and soybean seeds by 2017. France, in turn, has banned the use of neonicotinoids as of September 2018.

The value of neonicotinoids: seriously in question

The Pest Management Regulatory Agency (PMRA) determines the value of a given pesticide in light of three considerations: its effectiveness, its economic and competitive advantages, and its contribution to sustainable development.[68] For example, the PMRA confirms the value of clothianidin and imidacloprid for certain uses, since these substances provide the only means of thwarting the resistance developed by certain insect pests[69] and therefore of protecting certain crops.[70] However, the same cannot be said for all neonicotinoid uses. Indeed, since these insecticides were first introduced in the 1990s, various study findings have seriously undermined their value to the point of throwing their actual utility into question.

Certain insects have already developed resistance.[30] This is the case with imidacloprid, one of the most commonly used and against which many insect pest species — particularly the silverleaf whitefly (Besimia tabaci), green peach aphid (Myzus persicae), melon aphid (Aphis gossypii) and brown planthopper (Nilaparvata lugens) — are now resistant.[71, 72] According to the Arthropod Pesticide Resistance Database,[73] the first case of resistance worldwide was observed in 1994 in a single species, B. tabaci, and involved only imidacloprid. However, by 2016 a total of 28 insect species had developed resistance to seven neonicotinoids on the market. Thus, the more insect pests develop neonicotinoid resistance, the lesser the efficacy and, accordingly, value of these insecticides.

Various studies and literature reviews also cast into doubt the economic benefits of neonicotinoids,[30, 74] further eroding their value. In a recent U.S. study on soybean seeds coated with clothianidin, imidacloprid and thiamethoxam, the Environmental Protection Agency (EPA) concluded that their overall benefits to soybean production were negligible in most situations.[75] A three-year study in Indiana on the use of clothianidin-coated maize seeds came to the same conclusion.[76] In Québec, drawing on the research of Dr. Geneviève Labrie, the Centre de recherche sur les grains (CEROM) declared the systematic use of neonicotinoid-treated seeds unjustified in the province,[77] since few fields required treatment: for example, in abbreviated wireworm larvae (Hypolithus abbreviatus), the intervention threshold was reached in just 11.6% of the fields under study.[83] Dr. Labrie also showed the economic gains of using neonicotinoid-treated maize seeds to be insignificant.[78]

Lastly, in terms of contribution to sustainable development, the value of neonicotinoids has been diminished by their environmental impact. While the main criticisms to date have centred on the role of neonicotinoids in the decline of insect populations vital to plant pollination, particularly in commercial crops,[5, 22, 30, 44-47] these insecticides also harm the natural predators of insect pests, a consequence with the potential to override the anticipated pest control benefits.[27]

Before registering a pesticide, the PMRA must ensure that it presents no unacceptable risk to human health or the environment and that it has value in terms of efficacy, profitability and sustainability.[79] Based on these criteria, the PMRA recently granted full registration to three end-use products containing the active ingredient imidacloprid: Confidor 200 SL, designed to be injected into trees and which only had conditional registration until now[80, 81]; and Temprid SC and Temprid ReadySpray, both of which are used on mattresses to combat bedbugs, which constitutes a new use.[82, 83] The agency ruled that these products pose little risk to pollinators or the environment because of their treatment type (Confidor 200 SL: injection into trees) or application site (Temprid: house interiors). Conversely, the agency has proposed phasing out all agricultural and most other outdoor uses of imidacloprid, deemed too harmful for aquatic insects.[69]

Illegally registered in Canada?

About a decade ago, the PMRA granted conditional registration to two neonicotinoids, clothianidin and thiamethoxam, authorizing their sales in Canada despite lacking full scientific data on their impacts on human health and the environment. Today, the agency is still waiting to receive the manufacturers' data that would justify full registration of these products in Canada — products that continue to be used in the meantime. Given these facts, in 2016 Écojustice filed a against the PMRA[84] on behalf of a number of environmental groups for granting conditional registration to these pesticides. The suit aims to prove that the pesticides should never have been registered in Canada in the first place and that the PMRA's decision accordingly violates federal legislation.

However, there is some reassurance in the fact that this "approve now, study later" approach has since been outlawed in Canada, following the Health Minister's announcement[85] of the end of any such conditional registration.

The Canadian regulatory process: slow and fragmented

In 2012, Canada launched a re-evaluation of neonicotinoids[86] and their risks for pollinators. That year, the PMRA began receiving a high number of reports of bee deaths at the time of planting of neonicotinoid-treated corn and soy seed. In response, the agency increased incident monitoring in corn- and soybean-growing areas where the incidents were reported. The PMRA found that bees were being exposed to neonicotinoids through dust generated during the planting of treated seed. Its assessment report on the impact of neonicotinoids on pollinators in Canada is slated for publication in December 2017[87].

In November 2016, as part of its cyclical re-evaluation of health and environmental risks, the PMRA proposed a gradual phasing out of all agricultural and most other outdoor uses of imidaclopriden over a three- to five-year period. The evaluation identified concentrations of imidacloprid in Canadian aquatic environments at levels harmful to aquatic insects; it also indicated that the continued use of high volumes of imidacloprid in agricultural areas is unsustainable. However, the re-evaluation did not identify human health concerns from any exposure route when used according to current label standards.

The Health Minister will finalize her decision on imidacloprid in December 2018. The proposed schedule would therefore lead to elimination between 2021 and 2023 for a pesticide posing unacceptable risks to the environment.

Équiterre, the David Suzuki Foundation and the Canadian Association of Physicians for the Environment (CAPE) have expressed their concerns regarding the proposed re-evaluation decision on imidacloprid. These concerns target in particular the three- to five-year phase-out period, which will unnecessarily prolong the environmental risks, and the PMRA's dismissal of any risks to human health, since the evaluation fails to take into account studies on human populations and experimental research on human cells.

The PMRA has also announced that it will conduct special reviews of two other neonicotinoids, clothianidin and thiamethoxam[87], on the one hand regarding their risk to aquatic invertebrates (draft decision in spring 2018 and final decision in June 2019) and on the other, their risks to the squash bee (draft decision in December 2018 and final decision in March 2020). At the same time, the PMRA is currently re-evaluating these two neonicotinoids.

Table 6 : neonicotinoids re-evaluations and special exams planned in Canada over the next years.

Neonicotinoids Re-evaluations in Canada	Date expected
Clothianidin (proposed decision - pollinators)	December 2017
Imidacloprid (proposed decision – pollinators)	December 2017
Thiamethoxam (proposed decision – pollinators)	December 2017
Clothianidin (proposed decision)	To be determined
Thiamethoxam (proposed decision)	To be determined
Clothianidin (final decision)	To be determined
Thiamethoxam (final decision)	To be determined
Imidacloprid (final decision)	December 2018
Imidacloprid (final decision – pollinators)	December 2018
Clothianidin (final decision – pollinators)	December 2018
Thiamethoxam (final decision – pollinators)	December 2018
Neonicotinoids Special Reviews in Canada	**Date expected**
Clothianidin (aquatic invertebrates - proposed decision)	Spring 2018
Thiamethoxam (aquatic invertebrates – proposed decision)	Spring 2018
Clothianidin (squash bees – proposed decision)	December 2018
Thiamethoxam (squash bees - proposed decision)	December 2018
Imidaclopride (squash bees - proposed decision)	December 2018
Clothianidin (aquatic invertebrates – final decision)	June 2019
Thiamethoxam (aquatic invertebrates – final decision)	June 2019
Clothianidin (squash bees – decision finale)	March 2020
Thiamethoxam (squash bees – decision finale)	March 2020
Imidacloprid (squash bees – decision finale)	March 2020

Canada's Pest Control Products Act must ensure that the risks presented by pesticides to the environment and human health are acceptable. We do not see how that is possible to assess the collective impact of these structurally similar pesticides when each one is assessed individually and separately. We also worry about the time it has taken to assess each of these individual pesticides separately. Throughout the years required to complete these evaluations, our knowledge of the impacts of neonicotinoids has developed rapidly, while various neonicotinoids continue to be used and distributed broadly throughout our environment.

Conclusion

Initially hailed as the new heroes of pest management, neonicotinoids have certain properties that fostered their widespread adoption, particularly for agricultural uses. In recent decades, farmers have taken to using these insecticides prophylactically, particularly in the form of coated seeds — to the point where neonicotinoids have come to contaminate different environmental compartments (plant, soil and aquatic ecosystems). Many invertebrates that deliver invaluable ecosystem services have thus become exposed to neonicotinoids. Since these beneficial organisms are as sensitive to pesticides as the targeted insect pests, their roles and the services they render have become compromised.

Unquestionably, though, the most alarming impact of the extensive and systematic use of neonicotinoids is their role in the decline in pollinating insect populations: a phenomenon that ultimately threatens food security on a planet already undermined by climate change and the diversion of certain food crops toward energy production.

As if the environmental risks posed by neonicotinoids weren't enough, a number of studies have also shown their value to be limited. Their effectiveness is weakening, since a growing number of insect pests are developing resistance; their economic benefits are illusory, since they offer only marginal gains in terms of crop yields and have been deemed ineffective in most of the situations observed; and they fail to foster sustainable development, since they negatively impact a number of vital ecosystem services and threaten the predators of insect pests. According to the Task Force on Systemic Pesticides, neonicotinoids amount to a pest management fail:[30] a far cry from their early status as "heroes."

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