Global scientific review reveals effective, affordable alternatives to neonicotinoid and fipronil insecticides

Report finds systemic pesticides not as effective as once thought,
cites pest resistance as key reason to end mass uses of the harmful substances

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OTTAWA — Use of controversial neonicotinoid insecticides ("neonics") in agriculture is not as effective as once thought, and can be replaced by advantageous pest-management alternatives, according to a study published today in the academic journal *Environmental Science and Pollution Research*.

The latest publication of the Task Force on Systemic Pesticides reviews 200 studies to assess mass use of systemic insecticides in agriculture, focusing on their effects on crop yields and the development of pest resistance to these compounds after two decades. While neonics were first brought into use in 1991, documented resistance to them dates as far back as 1996. The authors identify a diverse range of alternative pest-management strategies available for large-scale crop production, concluding that a new framework is needed for a truly sustainable agricultural model that relies mainly on natural ecosystem services instead of highly toxic chemicals.

"Over-reliance on systemic insecticides for pest control is inflicting serious damage to the environmental services that underpin agricultural productivity," said Task Force co-chair and scientist at France's National Scientific Research Centre Jean-Marc Bonmatin. "This new research is exciting because it's proven the existence and feasibility of a number of alternative, integrated pest management models — which are far better for the environment without increasing costs or risks for farmers."

Neonicotinoids and the phenylpyrazole fipronil are the world's most sold systemic insecticides. They are routinely used in agriculture as seed treatments even where there is no relevant pest threat. After two decades of extensive neonics use, studies show these pesticides can have disastrous effects on biodiversity and ecosystems, including harm to pollinators. "Insecticides are expected to achieve higher yields and net incomes, but this certainly is not always the case," Bonmatin said. "The overwhelming evidence of negative effects on pollinators and arthropods needs to be weighed against the pest control benefits these systemic insecticides are supposed to produce."

Today's report cites many alternative integrated pest-management approaches that can be implemented in combination: at the landscape level (e.g., ecological corridors), by using better farming methods (e.g., crop rotation, resistant crop varieties), by taking advantage of biocontrol (e.g., predators and parasitoids) and through other means (e.g., traps, naturally derived insecticides).

The study also details results of an innovative insurance system that protects farmers against undue financial risks without causing environmental harm. Through a "mutual fund" insurance model piloted in Italy, a collective of farmers manages a mutual fund stock, creating compensation through an

interregional distribution of risks. Compensation is commensurate with the financial resources of the fund, which covers risks that private insurance companies currently do not, including climatic adversities such as flooding and damage by wild animals and pests.

“Crop insurance programs can be tailored to reduce the financial risk to farmers from potential pest infestations without the environmental costs of insecticide use,” Bonmatin said. “And on a cost-recovery basis, insurance premiums are far cheaper than insecticides, so farmers’ net incomes rise, too. It’s a win-win approach for farmers and the environment.”

The European Union is expected to vote soon on a proposal to expand its 2013 moratorium to cover most uses of neonics. France will phase-out all neonics next September. Canada is proposing to phase-out all agricultural uses of the neonic imidacloprid, with a final decision expected in December. Separately, Canada has also proposed to cancel some uses of other neonics (clothianadin and thiamethoxam), but would continue to permit their main use as seed treatments.

“Regulators need to realize that if we want sustainable agricultural practices, we need a more restrictive regulatory framework and programs to support farmers making the switch,” Bonmatin said. “Our findings on the availability of alternatives will be particularly relevant where new restrictions on neonics are being considered.”

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HIGHLIGHTS
ALTERNATIVES TO SYSTEMIC INSECTICIDES

Overview

A new study published in the academic journal *Environmental Science and Pollution Research* calls into question the value of neonicotinoid insecticides ("neonics") in agriculture. The research, conducted by the international Task Force on Systemic Pesticides, reviews more than 200 studies on the performance of neonics in controlling a wide range of insect pests on agricultural crops worldwide, including corn, wheat and many types of fruits and vegetables, as well as the available alternatives.

The study shows that the application of integrated pest management (IPM) principles and practices is affordable and effective. Major highlights include:

- The use of neonic-treated seeds does not increase crop yields in most cases
- Early and reliable detection methods to assess the risks of pest presence exist, at low costs
- Effective strategies are available to protect farmers against economic risks and achieve efficient pest control – e.g., the "mutual fund" (MF) model (described in further detail below), a novel insurance method designed to protect farmers against crop failure
- All scenarios – whether using IPM and/or insurance cover – are cheaper than using neonic-treated seeds

Drawing from studies throughout Europe, the review highlights evidence that widespread use of neonic seed treatments generally has little effect on crop yields because, in many cases, pest populations are below levels that would cause significant economic damage. Moreover, the review finds that the value of neonics is undermined by rapid development of resistance in target pests, and because the insecticides cause harm to insects and soil organisms that are beneficial to agriculture, such as bees and other pollinators.

Other effective alternatives are available and can benefit farmers, because crops cultivated without chemical insecticides may be sold at higher prices (e.g., certified organic produce). These alternatives include better farming methods (e.g., crop rotation, resistant crop varieties), biological control and crop insurance programs that are cheaper than insecticides and that compensate farmers for all events of losses, without placing any pressure on the environment.

Low-cost and reliable prediction method

The TFSP review highlights a model developed in Italy to predict which fields are at high risk of pest problems, in order to appropriately target pest management strategies. A 29-year, large-scale study characterized factors that increase risk of wireworm damage. Assessing the risk of wireworm damage provides a solid basis for identifying farmland that can be left untreated, without any risk of yield reduction – instead of indiscriminately using neonics on a prophylactic basis. In North-East Italy, 96 per cent of corn fields do not need any insecticide treatment (because relevant pest threats are not present above the economic damage level).

Novel Insurance Method

Where risks exist, the study shows that a "mutual fund" (MF) insurance model piloted at a very large scale in Italy is a cost-effective approach. It shows that the total cost of damage to maize (e.g., the need for re-sowing and yield loss) plus the MF cost was much lower than the total cost of the insecticide treatments, even when all the fields are left untreated. When adding IPM strategies to the MF strategy, the economic advantage was even greater. In addition to economic advantages, MF avoids the environmental harm associated with the use of neonics.

Evidence of harm

First introduced in the 1990s, neonics and fipronil — another systemic insecticide used in parts of Europe and Asia — are now the world's most sold insecticides. They are extremely toxic to biodiversity at very low doses because they are water-soluble and very persistent (i.e., do not readily degrade) in soil. This results in sustained and chronic exposure in terrestrial and aquatic environments. Scientists have further reported that extensive and routine application of neonics in agriculture is causing large-scale environmental contamination, including lethal and sub-lethal impacts to bees and other pollinators, as well as soil invertebrates, all of which are crucial to agriculture.

Main alternative methods of pest management

Landscape solutions	Farming methods	Biological control	Other methods
Ecological corridors	Insurance programs	Parasitoids	Traps
Trees (agroforestry)	Crop rotation	Predators: • Vertebrates • Invertebrates	Repellants
Edge crops	Tillage		Plant defence mediators
	Late sowing	Micro-organisms: • Fungi • Bacteria • Nematodes • Viruses	Naturally derived insecticides
	Resistant crop varieties		

"Only a tiny fraction of pesticide use serves its purpose to fight pests. The rest contaminates the environment."

– Task Force on Systemic Pesticides

Conclusion

Many governments have been slow to take action on neonics despite evidence of worldwide environmental contamination and harm to many species. Decision-makers frequently justify inaction on the basis that the controversial insecticides are a necessary tool for pest management, and that their withdrawal would cause economic losses in the agricultural sector.

The TFSP's review of the published evidence shows that alternative integrated pest management methods are available to protect farmers against economic risks and achieve efficient pest control below the economic injury level (Table 1). This latest study proves that neonics can be phased out without further delay to protect bees, aquatic invertebrates and other beneficial organisms, while maintaining agricultural productivity and even increasing benefits for farmers.

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