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Office of Pesticide Programs
Environmental Protection Agency
Docket Center (EPA/DC), (28221T),
1200 Pennsylvania Ave. NW.,
Washington, DC 20460-0001.

Re: Aquatic Ecological Assessment for Imidacloprid. Docket Number: EPA-HQ-OPP-2008-0844

Dear Sir/Madam,

We are pleased to submit these comments in response to the publication of the imidacloprid aquatic risk assessment. In 2016, the agency completed the preliminary pollinator risk assessment for imidacloprid, which identified risks to honey bees from agricultural uses. That assessment confirmed that imidacloprid is highly toxic to bees, and contaminates nectar and pollen of crops to which bees are exposed from multiple pathways.

Imidacloprid is a neonicotinoid insecticide with wide ranging agricultural and residential uses. However, imidacloprid and its class are highly toxic to many non-target invertebrates, including bees, which are in decline. It is used on a wide range of agricultural and non-agricultural sites, trees and turf, and pets. As a result of its widespread use, it is frequently detected in U.S. waterways. Its presence in these aquatic environments presents risks to aquatic organisms and other species dependent upon them. This assessment finds that aquatic invertebrates, especially aquatic insects, are the most sensitive to imidacloprid, and that current imidacloprid levels detected in waterways exceed acute and chronic toxicity endpoints.

The assessment's finding are consistent with those reported by the Canadian Pest Management Regulatory Agency (PMRA), which concludes that current levels of imidacloprid in aquatic environments pose risks to aquatic invertebrates. PMRA also notes that, "Based on currently available information, the continued high volume use of imidacloprid in agricultural areas is not sustainable."[1] As a result, the agency proposes to phase-out agricultural uses and much of the non-agricultural outdoor uses of imidacloprid over the course of three to five years. We urge the U.S. Environmental Protection Agency (EPA) to recognize that imidacloprid poses hazards to important aquatic species that can result in unintended trophic impacts. With

[1] PMRA. 2016. Proposed Re-evaluation Decision PRVD2016-20, Imidacloprid. Health Canada. Ottawa, Ontario.

levels of imidacloprid in U.S. waterways currently exceeding aquatic toxicity endpoints, it is incumbent on EPA to follow PMRA's lead and restrict imidacloprid's use.

Risks to Aquatic Invertebrates

Neonicotinoids are known for their action on non-target terrestrial insects, like the honey bee, but their neurotoxic activity in aquatic invertebrates like aquatic insects, crustaceans, and worms also occur when these chemicals get into waterways where these organisms reside. Neonicotinoids affect the nervous system of insects by interfering with their nicotinic acetylcholine receptors (nAChRs).[2] This mechanism of action shows higher selective toxicity in invertebrates compared to vertebrates.[3]

Aquatic insects are the most vulnerable to imidacloprid exposures, according to this preliminary assessment of imidacloprid's aquatic risks.[4] Specifically, EPA identifies mayflies as the most sensitive aquatic invertebrate to imidacloprid exposures. According to EPA, foliar spray and a combination of application methods have, "the greatest potential risks for aquatic invertebrates…." Freshwater invertebrate species that are listed under the Endangered Species Act (ESA) are also at elevated risk from foliar applications of imidacloprid. Soil applications also result in chronic concerns for both freshwater and saltwater invertebrates. EPA did not find direct risks to fish or amphibians, but the agency acknowledges that "the potential exists for indirect risks to fish and aquatic-phase amphibians through reduction in their invertebrate prey-base."

Specifically;

- Soil
  Soil applications result in acute and chronic risk to freshwater invertebrates for the "vast majority" of modeled scenarios.

- Foliar
  All foliar uses and combination uses can result in acute and chronic risks for freshwater invertebrates. Chronic risks were identified for saltwater invertebrates.

- Seed Treatment
  EPA still does not include impacts of contamination from abraded seed dust. Modeling finds that planting seeds at depths greater than 2 cm does not pose runoff risk to waterways. There are some acute and chronic risks for freshwater invertebrates, but not

[2] USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC.
[3] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374.
[4] USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC.

as high as other use patterns. Chronic risks were also identified for saltwater invertebrates.

- Surface Water Monitoring
  Monitoring data reviewed by EPA finds variable concentrations of imidacloprid in streams during the period 2000-2014. There are apparent decreases in concentration despite increased usage, which is attributed to increased soil and seed treatment uses compared to foliar applications. Nevertheless, the agency finds that these concentrations exceed acute and chronic toxicity endpoints for freshwater invertebrates.

These findings demonstrate that not only is imidacloprid pervasive in U.S. waterways at concentrations that exceed levels of concern and pose elevated risks to aquatic invertebrates, but also that use and subsequent concentrations of imidacloprid in waterways are not sustainable. Further, current water monitoring data, which EPA utilizes in its assessment, can underestimate real-world exposures to aquatic insects as sampling may not occur during peak concentrations, a sentiment shared by the agency's colleagues at PMRA.

Studies investigating the impacts of neonicotinoids on aquatic organisms find that these pesticides can have devastating impacts to aquatic communities. Van Dijk et al.'s (2013) comprehensive look at the effects of imidacloprid in surface water reports a wide variety of aquatic invertebrates adversely harmed by imidacloprid residues in water.[5] Even at low sublethal levels imidacloprid has the ability to reduce survival and growth, and can affect molting, and larval development. The effects of imidacloprid on certain aquatic organisms are wide-ranging and include significant reduction in abundance (zooplankton), significant reduction in survival (stonefly), reduced feeding (mayfly), and behavioral changes (cranefly).[6]

Still overlooked by EPA is that there can be additive and synergistic effects on non-target communities from imidacloprid exposures. Some pesticide combinations, for example, include certain fungicides combined with either pyrethroid or neonicotinoid insecticides that can increase toxicity synergistically.[7,8] Imidacloprid, for instance, has been found to act synergistically with inert ingredient mixtures that result in reduced population size of *Ceriodaphnia dubia* when compared to imidacloprid alone. Multiple pesticide combinations are found in waterways[9] and it is possible that synergistic effects between these chemicals occur in the environment. However, little is known about the mechanisms behind these synergistic

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[5] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374.
[6] Ibid.
[7] Wachendoorff-Neumann, U. et al. 2012. Synergistic mixture of trifloxystrobin and imidacloprid. Google patents United States Bayer CropScience AG.
[8] Andersch, W. et al. 2010. Synergistic insecticide mixtures. US Patent US 7,745,375 B2. Bayer CropScience AG
[9] Morrissey, C. A., Mineau, P, Devries, J, et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. *Environment International.* 74 (2015) 291–303.

interactions and their impact on aquatic invertebrates and ecosystems.

Current Aquatic Benchmarks Fall Short

According to the U.S. Geological Survey (USGS), water-quality benchmarks are estimates of "no-effect levels," meaning that real-world concentrations below the benchmarks are expected to have a low likelihood of adverse effects, while concentrations above a benchmark have a greater likelihood of adverse effects, which generally increases with concentration.[10]

For the neonicotinoids, there are some aquatic life benchmarks for fish, invertebrates and aquatic plants.[11] However, these benchmarks are derived from standardized laboratory testing of specific aquatic organisms, which many researchers have critiqued as not sensitive enough to pesticide exposures, and therefore result in underestimation of risk. Many note that the *Daphnia magna,* which is used as a standard aquatic test organism, appears to be approximately 100,000 times less sensitive than other aquatic invertebrates such as the *Ephemeroptera, Trichoptera,* or *Diptera* species.[12] The mayfly has been identified as the most sensitive aquatic species to imidacloprid. Ashauer et al. (2011) also find that *D. magna* is two to three orders of magnitude less sensitive to neonicotinoids than the freshwater crustacean, *Gammarus pulex.* [13] If *D. magn*a is more tolerant of neonicotinoids than other aquatic invertebrates, then its use to test the aquatic toxicity of neonicotinoids, or other pesticides, would result in benchmarks that are not protective of more sensitive species.

Current U.S. acute and chronic aquatic life benchmarks for invertebrates exposed to imidacloprid are 34.5 ug/L and 1.05 ug/L respectively. Studies have reported acute and chronic effects in aquatic organisms as low as 0.65 ug/L and 0.03 ug/L.[14,15] EPA notes that in water monitoring data reviewed reported detections ranged 1 ug/L – 7.94 ug/L. Starner and Goh (2012) found imidacloprid in California samples as high as 3.29 ug/L.[16] Compared to available aquatic benchmarks, real-world levels currently exceed chronic benchmark standards that have been set as a measure to protect sensitive species, as well as toxicity endpoints. EPA must revise current benchmarks for imidacloprid, and by extension other neonicotinoids, to reflect

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[62] USGS. Characteristics and Limitations of Screening-Level Assessments. National Water-Quality Assessment (NAWQA) Program. https://water.usgs.gov/nawqa/pnsp/benchmarks/characteristics.html

[11] USEPA. Aquatic Life Benchmarks for Pesticide Registration. https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-pesticide-registration

[12] Morrissey, C. A., Mineau, P, Devries, J, et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. *Environment International.* 74 (2015) 291–303.

[13] Ashauer, R, Hintermeister, A, et al. 2011. Acute toxicity of organic chemicals to *Gammarus pulex* correlates with sensitivity of *Daphnia magna* across most modes of action. Aquatic Toxicology. 103:38-45.

[14] Alexander AC, Culp JM, Liber K, Cessna AJ. 2007. Effects of insecticide exposure on feeding inhibition in mayflies and oligochaetes. *Environ. Toxicol. Chem.* 26: 1726–32.

[15] Roessink, I., Merga, L.B., Zweers, H.J. and Van den Brink, P.J., 2013. The neonicotinoid imidacloprid shows high chronic toxicity to mayfly nymphs. *Environmental toxicology and chemistry*, *32*(5), pp.1096-1100.

[16] Starner, K and Goh, K. 2012. Detections of the Neonicotinoid Insecticide Imidacloprid in Surface Waters of Three Agricultural Regions of California, USA, 2010–2011. *Bull Environ Contam Toxicol.* 88:316–321.

the adverse effects data. Use of old benchmarks means that their real-world levels pose significant risks to aquatic species that are being underestimated. These standards must be based on aquatic species that are the most vulnerable to imidacloprid exposures, like the mayfly, so as to not underestimate aquatic risks.

Cascading Ecosystem Effects

With reductions of aquatic invertebrate species, the availability of food for fish, amphibians and others like birds that prey on these organisms is directly affected. These disruptions can have long-term cascading effects on food webs and habitats in or near aquatic environments. Aquatic invertebrates play an important role in aquatic ecosystems. Many are predators and prey for other organisms, including fish.[17] However, aquatic ecosystems may experience direct and indirect effects, imbalance, and cascading effects on many trophic levels as a result of pesticide exposures.[18] For instance, altered predator-prey interactions between certain species exposed to neonicotinoids affects trophic interactions that in turn can affect ecosystem functions.[19] Impaired avoidance behaviors in prey species (e.g., mayflies) and accompanying increased predation by predator species (e.g., gammarids) can lead to reduced ecosystem function like reduced breakdown in detritus.

Studies have also shown imidacloprid to decrease species abundance in several types of organisms: crustaceans, true flies, mayflies, and snails.[20] Amphipod crustaceans and mayflies have the strongest decreases in abundance, which began at imidacloprid concentrations of 3.2 ug/L. Benthic communities also exhibited 5% reduction in abundance, according to some studies.[21]

Even at low sublethal levels imidacloprid has the ability to reduce survival and growth, and can affect molting, and larval development in aquatic organisms.[22] Effects such as these can have significant impact of total ecosystem function and health. This can have devastating impacts on aquatic communities and on the higher trophic organisms that depend on these communities. Imidacloprid's presence in aquatic environments therefore poses unreasonable risks to the long-term health and function of these sensitive environments.

Mitigating Risks Not Sufficient to Protect Vulnerable Species

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[17] Sánchez-Bayo F and Goka K. 2005. Unexpected effects of zinc pyrithione and imidacloprid on Japanese medaka fish (Oryzias latipes). Aquat Toxicol. 74(4):285-93.
[18] Colombo, V, Mohr, S et al. 2013. Structural Changes in a Macrozoobenthos Assemblage After Imidacloprid Pulses in Aquatic Field-Based Microcosms. *Arch Environ Contam Toxicol*. 65:683–692
[19] Englert, D, Bundschuh, M, Schulz, R. 2012. Thiacloprid affects trophic interaction between gammarids and mayflies. *Environmental Pollution.* 167 41-46
[20] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374
[21] Pestana JL, Alexander AC, Culp JM, et al. 2009. Structural and functional responses of benthic invertebrates to imidacloprid in outdoor stream mesocosms. Environ Pollut. 157(8-9):2328-34.
[22] Ibid

Despite current label statements, levels of imidacloprid in waterbodies pose risks to aquatic insects. In a similar assessment conducted by PMRA, the Canadian agency believes that "effective risk mitigation through a use-reduction strategy would be difficult to achieve…"[23] Specifically, the agency states, "[I]t would be difficult to identify the specific uses that are causing the elevated levels in water, given that much of the water monitoring data were from mixed-use areas of agriculture. In addition, it is not possible to accurately predict how much use reduction would be necessary to achieve acceptable levels of imidacloprid in the environment and, therefore, any use-reduction strategy would require extensive and comprehensive water monitoring information to confirm that risk reduction targets are being achieved."[24] Any mitigation measures to reduce imidacloprid contamination, especially in waterways, would not be realistic, and most likely not sustainable or achievable. Imidacloprid use is poised to increase, with subsequent increases in environmental risks. Further, mitigation measures would not meet mitigation goals or protect sensitive species. Therefore, restrictions to imidacloprid's use must be implemented.

International Imidacloprid Assessments.

Given the frequency of detection in Canadian waterbodies, and the risks posed to aquatic organisms, PMRA proposed a phase-out of the chemical over a period of three to five years. PMRA notes, "Based on currently available information, the continued high volume use of imidacloprid in agricultural areas is not sustainable." The agency finds further mitigation of risks would be unrealistic, unsustainable, and inadequate to protect sensitive aquatic species. Based on this, PMRA is proposing to phase out outdoor agricultural uses, including seed treatment, and use on lawns and turf. A final decision on this proposal is due December 2017.

Similarly, the European Food Safety Authority (EFSA) identified aquatic insects as the most sensitive species to imidacloprid. EFSA reports acute toxicity to aquatic invertebrates ranging from 0.65 to 284 µg /L for insects, and chronic toxicity ranging between 0.024 - 4.57 µg/L,[25] values that are comparable to those found in independent sources. EFSA finds high acute and chronic risk to aquatic organisms from imidacloprid uses on certain crops. Restrictions for imidacloprid and other neonicotinoids have also been proposed by the European Commission.[26]

EPA acknowledges its findings are consistent with both EFSA and PMRA, and therefore we believe EPA must also take measures to restrict imidacloprid use.

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[23] PMRA. 2016. Proposed Re-evaluation Decision PRVD2016-20, Imidacloprid. Health Canada. Ottawa, Ontario.
[24] Ibid
[25] EFSA. 2014. Conclusion on the peer review of the pesticide risk assessment for aquatic organisms for the active substance imidacloprid. https://www.efsa.europa.eu/en/efsajournal/pub/3835
[26] http://www.pan-europe.info/sites/pan-europe.info/files/20170323_European%20Commission%20to%20completely%20ban%20neonicotinoids.pdf

Conclusion

Given the frequency of detection in U.S. waterways, and the acute and chronic risks posed to aquatic invertebrates, we urge EPA to restrict uses of imidacloprid. Direct threats to aquatic invertebrates, as well as indirect threats to higher trophic organisms have been identified by the agency. Current methods for evaluating aquatic toxicity are underestimating risks so that federal benchmarks are not protective of more sensitive species. Given the toxicity of imidacloprid on non-target organisms, beneficial invertebrates, and current regulatory deficiencies (federal aquatic benchmarks), it is imperative that action be taken to limit its presence in U.S. waters.

Sincerely,

Nichelle Harriott
Science and Regulatory Director