Comments on the pollinator re-evaluation of imidacloprid

Submitted to the Pest Management Regulatory Agency
August 29, 2018

These are the joint comments of the David Suzuki Foundation, Équiterre, Environmental Defence, the Canadian Association of Physicians for the Environment (CAPE) and the Canadian Environmental Law Association on the pollinator re-evaluation of imidacloprid and its end use products (PRVD2018-12). Our organizations have a long history of advocacy for effective pesticide regulation to protect the environment and human health. Pollinator protection is at the nexus of these two concerns. Pollinators play a crucial role in sustaining biodiversity and natural ecosystems, as well as assuring food security. Of 124 major commodity crops directly used for human consumption, 70 per cent are dependent on pollination for enhanced production.[1,2]

As a preface to our comments on PRVD2018-12, we wish to restate our support for the proposed phase-out of agricultural and most other outdoor uses of imidacloprid, in line with the broader re-evaluation of imidacloprid published in 2016 (PRVD2016-20). While the proposed phase-out addresses risks to aquatic invertebrates, it will also benefit pollinators. However, we are concerned that the unjustifiably long timeline for the proposed phase-out (three to five years after publication of the final decision, expected in December 2018) will prolong confirmed risks and indeed result in increased environmental contamination in the near term. We urge the PMRA to match the EU timeline and end the use of imidacloprid and other neonicotinoids in Canada by the end of 2018,

There have already been extensive delays in PMRA risk assessments and decision-making. A prolonged phase-out is not justified.

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[1] Chagnon, Madeleine, David Kreutzweiser, Edward A.D. Mitchell, Christy A. Morrissey, Dominique A. Noome, and Jeroen P. Van der Sluijs. "Risks of Large-Scale Use of Systemic Insecticides to Ecosystem Functioning and Services." *Environmental Science and Pollution Research* 22, no. 1 (January 2015): 119–34. https://doi.org/10.1007/s11356-014-3277-x.

[2] Klein, A.-M., B. E Vaissiere, J. H Cane, I. Steffan-Dewenter, S. A Cunningham, C. Kremen, and T. Tscharntke. "Importance of Pollinators in Changing Landscapes for World Crops." *Proceedings of the Royal Society B: Biological Sciences* 274, no. 1608 (February 7, 2007): 303–13. https://doi.org/10.1098/rspb.2006.3721.

Many of the comments we submitted previously in response to the consultation on the pollinator re-evaluations of clothianadin and thiamethoxam (PRD2017-17 and PRVD2017-23) are also applicable to the re-evaluation of imidacloprid. We list our recommendations in Appendix A and discuss them below in further detail.

As a general comment, we are concerned that Canada continues to lag well behind the European Union in the regulation of neonicotinoids. We are also concerned that the PMRA continues to maintain a piecemeal approach to risk assessments on neonicotinoids, undertaking at least 10 separate risk assessments over 8 years. This disjointed approach does not appropriately reflect scientific concerns of ecosystem-level impacts, nor does it acknowledge the extensive and concurrent application of these top-selling insecticides in Canada that results in widespread ecosystem-level contamination. A more comprehensive ecosystem-level approach is needed in the regulatory assessment of all pesticides, including neonicotinoids.

We focus our comments on the following issues:

I. **The proposed phase-out of certain uses**
II. **The narrow scope of the assessment**
III. **Risks to pollinators from contamination of the broader environment**
IV. **Total exposure and cumulative risks**
V. **The value of imidacloprid**

I. The proposed phase-out of certain uses

We urge the PMRA to move forward immediately with the proposed deregistration of imidacloprid for: foliar application to pome fruit, stone fruit, tree nuts with high pollinator attractiveness, and small fruit and berries; soil application on legume vegetables, fruiting vegetables, cucurbit vegetables, herbs, and small fruit and berries; and soil applications to ornamental crops that will result in pollinator exposure.

Considering the PMRA does not expect to publish the final re-evaluation decision until December 2018 – more than six years after the pollinator re-evaluations were launched – further delays in the implementation of risk mitigation measures should be avoided. Every additional season that these products remain in use prolongs unacceptable risks to crucial pollinators and worsens the problem of environmental contamination. A prolonged phase-out is not justified.

Recommendation 1: The PMRA should immediately deregister imidacloprid uses/products proposed for phase-out without any further delay.

With respect to other applications of imidacloprid proposed for continued use in Canada, we are concerned that the re-evaluation takes an unrealistically narrow view of, and therefore underestimates, some exposure risks. We are also concerned that proposed mitigation measures are inadequate to reduce identified risks to pollinators to “acceptable” levels.

The proposed re-evaluation decision generally mirrors the approach the European Union adopted in 2013, to protect honey bees, although the PMRA’s proposal is considerably more

limited in scope.[3] EU Regulation No 485/2013 prohibited all uses of clothianidin, imidacloprid and thiamethoxam in bee-attractive crops with the exception of uses in greenhouses, on winter cereals, and on some crops after bloom. The measure was based on the European Food Safety Authority's (EFSA) 2012 pollinator risk assessments.[4]

A half-decade ago, when the EU introduced Regulation No 485/2013, it was an appropriately precautionary response to the global pollinator crisis, based on the information available at the time. However, subsequently EFSA has updated its pollinator risk assessments for neonics in light of new evidence of harm[5] and in April 2018, EU member states voted to extend the moratorium. The new EU regulations prohibit all outdoor uses of the three main neonics starting December 19, 2018. We find it concerning that the PMRA is proposing to largely replicate the EU's now-outdated partial restrictions, when the EU itself has now adopted a more comprehensive approach.

In our view, the approach used by EFSA in its updated assessments to address variability in the level of risk is preferable. While identifying some lower risk use/exposure scenarios, EFSA concludes that **overall the risk to bees – both honey bees and wild bees - is confirmed.** In most of the cases where some low risks were identified for a particular use, high risks were also identified for the same use. The new EU regulations banning all outdoor uses of imidacloprid, clothianidin and thiamethoxam is a more reliable way to reduce overall risks to pollinators.

Recommendation 2: PMRA should revise its risk assessment conclusions to recognize the* overall *risk to pollinators and deregister all outdoor uses.

The risk mitigation strategies proposed in PRVD2018-12, apart from the few uses that would be cancelled, rely on label statements to indicate restrictions on use. However, there is an important information gap in this approach. A recent literature review of studies published worldwide found critical gaps in knowledge regarding the efficacy of labelling for mitigating risks.[6] While this review mainly included studies from developing countries and of migrant workers, it identified the lack of adequate data in the EU and elsewhere to assess efficacy of labelling.

The use of label modifications makes risk mitigation the responsibility of end users while the risk of non-compliance has far-reaching consequences. We appreciate that the PMRA has recently begun to report annually on its compliance and enforcement activities. While such efforts, and reporting on them, are laudable, the 2015-16 and 2016-17 Compliance and Enforcement Reports indicate how limited such inspection and enforcement efforts are at the farm level across a country as vast as Canada. Both the 2015-16 and 2016-17 reports note

[3] For example, the EU moratorium extends to corn and rapeseed and prohibits the use of neonic-treated seeds for target crops, whereas the PMRA proposes no regulatory action on these uses.
[4] https://www.efsa.europa.eu/en/topics/topic/bee-health
[5] EFSA. Neonicotinoids: risks to bees confirmed. News release. February 28, 2018. https://www.efsa.europa.eu/en/press/news/180228
[6] Remoundou, Kyriaki, Mary Brennan, Andy Hart, and Lynn J. Frewer. "Pesticide Risk Perceptions, Knowledge, and Attitudes of Operators, Workers, and Residents: A Review of the Literature." *Human and Ecological Risk Assessment: An International Journal* 20, no. 4 (July 4, 2014): 1113–38. https://doi.org/10.1080/10807039.2013.799405.

that uses contrary to the label were among the most common areas of non-compliance. Both reports also note that compliance and enforcement activities have focused in areas of particularly high risk. While such an approach makes the best use of scarce resources, the consequence is an inspection capacity that is woefully inadequate to monitor compliance with label restrictions.

Given our overriding concern that neonicotinoids should be removed from widespread use in light of the serious environmental risks discussed herein, we are not confident that the PMRA has the capacity to either ensure compliance with proposed label changes or assess their effectiveness.

In the absence of our preferred approach of a full ban on imidacloprid and other neonicotinoids, we urge a robust, independent evaluation of the effectiveness of precautionary label statements on neonic pesticides within a Canadian context. Beyond these immediate concerns with the risks associated with neonics, such studies are more broadly necessary to ascertain with a high degree of confidence whether those applying pesticides and pesticide-treated seeds in Canada read, understand and follow label requirements aimed at reducing risk.

We believe that tinkering with label requirements on multiple products is not a credible response to the immediate ecological risks posed by these pesticides.

Recommendation 3: In the absence of a full ban on imidacloprid and other neonicotinoids, PMRA should investigate the effectiveness of label statements in reducing ecological risks and increase capacity to ensure monitoring and compliance.

II. The narrow scope of the assessment

a) PRVD2018-12 does not evaluate risks to all pollinators and the title misrepresents its scope.

The assessment purports to evaluate risks to apis and non-apis bees. However, with respect to non-apis bees, most of the referenced studies are on bumblebees and the assessment frequently relies on honey bee data as a surrogate. Kopit and Pitts-Singer note that testing only honey bees as the surrogate for all bees results in an incomplete assessment of pesticide effects on native bee species and other wild pollinators.[7] There are some 800 species of bees in Canada. Uncertainties regarding effects on native bee species and the failure to consider unique behaviours that could increase exposure are critical gaps in the assessment. Cavity nesting bees, for example, can be exposed to neonicotinoids (and other systemic and translaminar pesticides) in the leaves they use in nest construction -- in addition to exposure from nectar and pollen while foraging.[8] As well, soil and seed treatment applications may be expected to result in higher levels of exposure for ground-nesting

[7] Kopit, Andi M and Theresa L Pitts-Singer. "Routes of Pesticide Exposure in Solitary, Cavity-Nesting Bees" *Environmental Entomology*, Volume 47, Issue 3, 6 June 2018, Pages 499–510, https://doi.org/10.1093/ee/nvy034.
[8] *Ibid.*

solitary bees, which comprise about 70 per cent of native bee species. The assessment also fails to consider impacts on all other wild pollinators beyond bees that could be at risk from exposure to neonicotinoids.

Whereas honey bees are managed by the Canadian honey industry, other pollinator populations are not similarly managed. For example, honey bee queens are produced or imported by beekeepers whereas no comparable intervention occurs for threatened wild pollinators to maintain healthy populations. Wild pollinators include: native bees, flies, butterflies, wasps, moths, beetles, and vertebrates, like bats, squirrels, birds and some primates.[9,10,11,12,13] Beyond providing valuable ecosystem services, wild pollinators play a critical role within food webs. A loss of pollinating species has been shown to impair ecosystem functioning as a whole.[14,15] According to the Worldwide Integrated Assessment of the Impact of Systemic Pesticides on Biodiversity and Ecosystems,[16] "adverse impacts of wide-scale insect pollinator and predator loss can lead to cascade effects in biotic communities that can ultimately affect human populations."

Some particular crops and plants are pollinated by unique pollinators, and the survival of certain host plants is directly linked to the survival of their pollinating species.[17] Kearns and Inouye[18] and Ollerton et al[19] explain how hundreds of plant species are often dependent on a distinct and unique wasp species for pollination, and that those plant species often provide staple food or habitat for many vertebrates. The loss of the wasps in these cases as a keystone species has the potential to shift the whole structure of the biotic community. The PMRA has failed to identify if any of these kinds of unique pollinator-host plant species exist in Canada; they would merit a more in-depth risk assessment.

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[9] Buchmann SL (1997) *The forgotten pollinators*. Island Press, Washington, DC, p 312.

[10] Klein *et al* 2007, *op cit*.

[11] De Luca, Paul A, and Mario Vallejo-Marín. "What's the 'Buzz' about? The Ecology and Evolutionary Significance of Buzz-Pollination." *Current Opinion in Plant Biology* 16, no. 4 (August 2013): 429–35. https://doi.org/10.1016/j.pbi.2013.05.002.

[12] Ghanem, Simon J., and Christian C. Voigt. "Increasing Awareness of Ecosystem Services Provided by Bats." In *Advances in the Study of Behavior*, 44:279–302. Elsevier, 2012. https://doi.org/10.1016/B978-0-12-394288-3.00007-1.

[13] Vanbergen, Adam J, and the Insect Pollinators Initiative. "Threats to an Ecosystem Service: Pressures on Pollinators." *Frontiers in Ecology and the Environment* 11, no. 5 (June 2013): 251–59. https://doi.org/10.1890/120126.

[14] Bartomeus, Ignasi, Mia G. Park, Jason Gibbs, Bryan N. Danforth, Alan N. Lakso, and Rachael Winfree. "Biodiversity Ensures Plant-Pollinator Phenological Synchrony against Climate Change." Edited by Micky Eubanks. *Ecology Letters* 16, no. 11 (November 2013): 1331–38. https://doi.org/10.1111/ele.12170.

[15] LaBar, Thomas, Colin Campbell, Suann Yang, Réka Albert, and Katriona Shea. "Global versus Local Extinction in a Network Model of Plant–pollinator Communities." *Theoretical Ecology* 6, no. 4 (November 2013): 495–503. https://doi.org/10.1007/s12080-013-0182-8.

[16] Chagnon *et al*, 2015, *op. cit*.

[17] Kim, Ke Chung. "Biodiversity, Conservation and Inventory: Why Insects Matter." *Biodiversity and Conservation* 2, no. 3 (June 1993): 191–214. https://doi.org/10.1007/BF00056668.

[18] Kearns, Carol Ann, and David William Inouye. "Pollinators, flowering plants, and conservation biology: much remains to be learned about pollinators and plants." *BioScience*, vol. 47, no. 5, 1997, p. 297-307.

[19] Ollerton, Jeff, Rachael Winfree, and Sam Tarrant. "How Many Flowering Plants Are Pollinated by Animals?" *Oikos* 120, no. 3 (March 2011): 321–26. https://doi.org/10.1111/j.1600-0706.2010.18644.x.

In sum, pollinators in general -- not just honey bees and bumblebees -- are instrumental in increasing the genetic diversity in plant species,[20] and thus are not only important for healthy ecosystems and biodiversity but also for human diets, the resilience of our global food system, and the Canadian economy.

Recommendation 4: The PMRA should more accurately present PRVD2018-12 as a re-evaluation of risks to bees (not all pollinators), and adopt a precautionary approach to protect solitary bees, given their potential for greater exposure and lack of data on effects. Even though the assessments were limited in that they did not consider impacts on all pollinators, the evidence of impacts on honey bees and bumblebees should be significant enough to deregister these pesticides immediately.

b) Dust mitigation measures are insufficient to protect pollinators.

The PMRA and other leading authorities have previously identified dust generated from the planting of neonicotinoid-treated seed as a contributing factor in declining bee health,[21,22] and PRVD2018-12 identifies a potential risk of exposure to imidacloprid in dust from certain crop groups (cereals and oilseeds). Yet the PMRA concludes the risk is minimal and proposes only label statements requiring best management practices to mitigate risks from dust. The proposed re-evaluation offers no assessment of the effectiveness of the best management practices apart from fewer reports of bee mortality incidents coinciding with the planting of seeds treated with other neonicotinoids following introduction of the BMPs (as well as requirements for dust-reducing fluency agents) in 2014.

Honeybee incident report trends are an insufficient basis for dismissing risks to pollinators from treated seeds. In particular, the honeybee incident reporting mechanism is poorly suited to provide information about native bee exposure or known sublethal effects such as hygienic behaviour, and the abilities of colonies to sustain an actively laying queen overtime.

It is reasonable to assume that the new best management practices and requirements for dust-reducing fluency agents, where they have been applied, may have reduced (not eliminated) dust generated during the planting of treated seeds. But the risk assessments offer no information about compliance rates or evaluation of pollinator exposure to residual levels of dust nor the extent to which the proposed label statements for treated seeds can be expected to improve compliance with BMPs.

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[20] Benadi, Gita, Nico Blüthgen, Thomas Hovestadt, and Hans-Joachim Poethke. "When Can Plant-Pollinator Interactions Promote Plant Diversity?" *The American Naturalist* 182, no. 2 (August 2013): 131–46. https://doi.org/10.1086/670942.

[21] Tapparo, Andrea, Daniele Marton, Chiara Giorio, Alessandro Zanella, Lidia Soldà, Matteo Marzaro, Linda Vivan, and Vincenzo Girolami. "Assessment of the Environmental Exposure of Honeybees to Particulate Matter Containing Neonicotinoid Insecticides Coming from Corn Coated Seeds" *Environmental Science & Technology* 2012 46 (5), 2592-2599. https://doi.org/10.1021/es2035152

[22] Nuyttens, David and Pieter Verboven. "Dust Emission from Pesticide Treated Seeds During Seed Drilling" *Outlooks on Pest Management* vol. 26, no. 5, October 2015, pp. 215-219(5). https://doi.org/10.1564/v26_oct_07

Recommendation 5: In the absence of evidence, it cannot be assumed that best management practices are sufficient to reduce neonicotinoid exposures to acceptable levels.

c) Risk mitigation measures are needed for seed crops

The risk assessment concludes that use of imidacloprid on crops harvested before bloom pose negligible risk to pollinators because no exposure is expected (pre-bloom, these crops are not attractive to pollinators since there is no nectar or pollen source available). A potential risk is indicated when the same crops are grown for seed production yet no new risk mitigation measures are proposed. According to the Canadian Seed Growers' Association, 1.2 million acres of seed crops were planted in Canada in 2012 – mainly cereals, oilseeds and pulses, but also including 1,200 acres of "minor crops".[23]

Recommendation 6: If the PMRA continues registration of uses on crops that are typically harvested before bloom, as proposed, a label statement should be added prohibiting use on seed crops – even if these crops are not typically grown for seed in Canada at present.

d) Risks from non-agricultural turf uses are underestimated and unacceptable

The cosmetic use of imidacloprid on private and public lawns poses needless risks to pollinators and therefore even minimal risk should be deemed unacceptable. Moreover, the assessment almost certainly underestimates actual risk by (a) assuming effective irrigation following application and (b) overlooking risks from residues on non-target plants adjacent to treated turf. As mentioned above, we are not aware of evidence to support the assumption that label restrictions are effective in reducing ecological risks to acceptable levels. This assumption is particularly questionable in the case of the domestic-class imidacloprid turf product. Residential sprinkler systems or hand watering may not provide effective irrigation of all treatment areas. Furthermore, ornamental gardens are common in proximity to residential turf and may include flowering plants that are attractive to bees. We expect levels of imidacloprid residues in non-target plants adjacent to treated residential turf might be higher than in other treatment settings because of proximity and because the general public can apply the domestic-class turf product.

Recommendation 7: PMRA should recognize risks from the cosmetic use of imidacloprid as unacceptable and deregister non-agricultural turf products.

e) PRD2016-16 does not suffice to assess risks to pollinators from imidacloprid tree injections

The PMRA claims to have assessed risks to pollinators from imidacloprid tree injections separately in the recent registration decision for the end-use product Confidor 200 SL

[23] Canadian Seed Growers' Association. Seed Industry Stats. http://seedgrowers.ca/seed-industry-stats/

(PRD2016-16) and therefore excludes it from the pollinator re-evaluation. In our view, this is an inappropriate omission and risks may be underestimated as a result. The assessment of pollinator risks in the Confidor 200 SL registration decision relied on a single unpublished study of residue levels in red maples and includes several uncertainties that generally result in less conservative – and in some cases unreliable – findings, as the PMRA notes in PRD2016-16.

Nevertheless, the data presented in PRD2016-16 show maximum imidacloprid residues in the leaves of treated trees measured 14,963 ppb. Neither PRD2016-16 nor PRVD2018-12 present an assessment of the environmental fate of residues in deciduous tree leaves following abscission and potential risks to pollinators. Imidacloprid can persist in soil from one growing season to another. As leaf litter from treated trees decomposes, it is possible that non-target plants growing in the area (which in the urban setting would commonly include bee-attractive clover and dandelions) may take up residual imidacloprid from the soil. This suggests an additional source of exposure for bees.

The final registration decision for Confidor 200 SL (RD2017-02) indicates that the PMRA received no comments on the proposed decision. As a procedural matter, we reasonably expect the opportunity to comment on all risks to pollinators during the present consultation on the pollinator re-evaluation of imidacloprid. Exclusion of tree injection applications from PRD2018-12 further demonstrates a fragmented approach to assessment that obscures overall exposure risks.

Recommendation 8: PMRA should more thoroughly assess risks to pollinators from imidacloprid tree injections.

III. Risks to pollinators from contamination of the broader environment

A significant limitation of the risk assessment is its failure to adequately evaluate the potential for exposure to imidacloprid beyond the treated field. There is clear evidence of widespread environmental contamination by neonics. Imidacloprid (as well as clothianidin and thiamethoxam) is persistent in soil and has been detected in water samples across the country,[24,25,] likely as a result of agricultural runoff and leaching, as well as spray drift. It is reasonable to expect that plants in the vicinity of treated fields could also become contaminated. Non-treated plants – both adjacent agricultural crops and other vegetation – may take up neonics as the chemicals move through the soil and water, and also be contaminated by dust generated during the planting of treated seeds and spray drift. Residues in the pollen and nectar of these plants could become a source of exposure, especially if they are attractive to bees. Indeed the PRVD2018-12 reference list includes a small number of studies indicating potential risk from contaminated wildflowers.

[24] Ontario Agency for Health Protection and Promotion (Public Health Ontario), Somers N., Chung R. Case study: Neonicotinoids. Toronto, ON: Queen's Printer for Ontario; 2014. https://www.publichealthontario.ca/en/eRepository/Case_Study_Neonicotinoids_2015.pdf

[25] Anderson, J.C., C. Dubetz, and V.P. Palace. "Neonicotinoids in the Canadian Aquatic Environment: A Literature Review on Current Use Products with a Focus on Fate, Exposure, and Biological Effects." *Science of The Total Environment* 505 (February 2015): 409–22. https://doi.org/10.1016/j.scitotenv.2014.09.090.

a) PRVD2018-12 inappropriately dismisses risks to pollinators from residues on non-target wildflowers.

The Tier 2 assessment for seed treatment applications identified a potential risk to pollinators from imidacloprid residues on wildflowers adjacent to treated fields. We disagree with the PMRA's decision to summarily dismiss this risk on the basis that the single relevant study included in the assessment likely over-estimated exposure. While the study used residue levels in the whole flower as a surrogate for pollen and nectar, a conservative and precautionary approach is appropriate given the potential for harm. Furthermore, a separate study of hives near cornfields planted with neonicotinoid-treated corn identified residues in pollen from non-target plants at toxicologically relevant levels.[26] Although this study focused on contamination from clothianidin seed treatments, its findings reinforce the potential risk to pollinators from neonicotinoid seed treatments via exposure to residues in non-target plants.

Neonicotinoid treated seeds are a major source of environmental contamination, as seed treatments represent the most widespread use of neonics in the US[27] and likely in Canada and worldwide. In addition to the registered seed treatments listed in Appendix 1 of the consultation document, seeds treated in other countries may be imported and planted in Canada under the *Seeds Act*. PRVD2018-12 claims that corn and soybean seeds in Canada are not typically treated with imidacloprid, but in Ontario alone more than half a million hectares of these two crops were planted with imidacloprid-treated seed in 2017.[28]

The Tier 1 assessment of soil applications also identified a potential chronic risk to forager bees from residues in wildflowers, but in this case the Tier 2 refined assessment did not identify a risk (based on a single study). Strangely, the assessment of foliar applications does not address potential risks from residues in non-target plants and this is a notable gap.

Recommendation 9: PMRA should not dismiss the identified risk from residues in wildflowers adjacent to fields planted with imidacloprid-treated seeds and should assess risks from residues in non-target plants (including wildflowers) in connection with foliar applications.

b) The use of imidacloprid on crops that are not attractive to bees or are harvested pre-bloom, as well as post-bloom foliar applications, may contaminate non-target plants with different bloom cycles.

The PMRA proposes to restrict certain foliar applications of imidacloprid to prevent spraying before and/or during bloom for specific crops. This approach is intended to protect pollinators by ensuring the pesticide is not sprayed during times when bees may be foraging

[26] Tsvetkov, N., O. Samson-Robert, K. Sood, H. S. Patel, D. A. Malena, P. H. Gajiwala, P. Maciukiewicz, V. Fournier, and A. Zayed. "Chronic Exposure to Neonicotinoids Reduces Honey Bee Health near Corn Crops." *Science* 356, no. 6345 (2017): 1395–1397.

[27] Douglas, Margaret R., and John F. Tooker. "Large-Scale Deployment of Seed Treatments Has Driven Rapid Increase in Use of Neonicotinoid Insecticides and Preemptive Pest Management in U.S. Field Crops." *Environmental Science & Technology* 49, no. 8 (April 21, 2015): 5088–97. https://doi.org/10.1021/es506141g.

[28] Ontario.Neonicotinoid regulations for seed vendors. End of year reporting. https://www.ontario.ca/page/neonicotinoid-regulations-seed-vendors#section-5

on the treated field. However, as noted above, contamination of non-target plants is a concern and these plants may have different bloom cycles. Furthermore, recent findings in ecotoxicology suggest that some chemicals, including neonicotinoids, can produce toxic effects at any concentration provided a sufficiently long time of exposure [29,30] which means that limiting the timing of application is not an adequate risk management strategy.

Similarly, the use of imidacloprid on crops that are not themselves attractive to bees and crops typically harvested pre-bloom may nevertheless affect bees via residues in non-target plants beyond the treated field. The PMRA's conclusion that these uses do not pose a risk to pollinators because exposure is not expected takes an unrealistically narrow view and fails to consider the overall effect of widespread environmental contamination from all uses of imidacloprid (and other neonicotinoids).

Because most neonicotinoid insecticides are persistent in soil and water, maintaining any neonicotinoid contamination in the environment is likely to potentially affect a broad range of biological organisms that provide ecosystem services, posing risks to ecosystem functioning and services.[31]

Recommendation 10: The assessment should take into account the contribution of all applications to environmental contamination and resulting risks to pollinators from residues in non-target plants. At a minimum, all foliar uses for which restrictions are proposed to prevent spraying pre-bloom and/or during bloom should be deregistered altogether.

IV. Total exposure and cumulative risks

a) PRVD2018-12 does not evaluate the total exposure risk to pollinators from all applications of imidacloprid

The assessment evaluates each registered use of imidacloprid separately but fails to present an evaluation of total exposure risk to pollinators. In the case of several uses proposed for continued registration, potential risks to pollinators were identified but considered acceptable in isolation. Yet considering the widespread use of imidacloprid and the large radius covered by some pollinators (the typical foraging area for honey bees extends 3 km or more from the hive), it is reasonable to assume that pollinators are exposed to imidacloprid from multiple sources, including multiple applications and uses. Furthermore, measures of acute or even chronic exposure of adult bees likely inadequately address longer chronic toxicity, larval toxicity, or sublethal effects, particularly in the case of systemic insecticides like neonicotinoids that remain in plants for a long time, including through plant bloom and are

[29] Tennekes H.A. "The Significance of the Druckrey-Küpfmüller Equation for Risk Assessment - The Toxicity of Neonicotinoid Insecticides to Arthropods Is Reinforced by Exposure Time." *Toxicology* 276, no. 1 (September 2010): 1–4. https://doi.org/10.1016/j.tox.2010.07.005.

[30] Rondeau, Gary, Francisco Sánchez-Bayo, Henk A. Tennekes, Axel Decourtye, Ricardo Ramírez-Romero, and Nicolas Desneux. "Delayed and Time-Cumulative Toxicity of Imidacloprid in Bees, Ants and Termites." *Scientific Reports* 4, no. 1 (May 2015). https://doi.org/10.1038/srep05566.

[31] Chagnon *et al* 2015, *op.cit.*

then transferred to pollen and nectar.[32] Individually minimal exposure risks add up in real-world scenarios.

Recommendation 11: PMRA must evaluate the total exposure risk to pollinators from all applications and all uses of imidacloprid, including residues in non-target plants.

b) Additive and cumulative effects of exposure to multiple neonicotinoids, and other pesticides, have not been considered.

All neonicotinoids have the same mechanism of toxicity, which means that their impacts may be additive (or worse) in field conditions in which multiple neonicotinoids are used. Without conducting an assessment on cumulative effects that appreciates the scale at which neonicotinoids are concurrently used in Canada, the Minister cannot conclude that the risks posed by imidacloprid (and other individual neonicotinoids) are acceptable.

There is also evidence that exposure to neonicotinoids can increase disease and pests that impact bees. A study in Quebec found honeybee colonies located in neonic-treated corn fields with significantly higher burdens of viruses and biomarkers of physiological stress than those in untreated fields suggesting an indirect weakening of honeybee health via induction of stress and increased pathogen loads.[33] A second year of study on these hives found similar results.[34] Although this particular study looked at hives near fields planted with thiamethoxam-treated seeds, the possibility of a similar and additive effect in the presence of imidacloprid should be investigated.

Recommendation 12: The PMRA should assess additive and cumulative effects on pollinators based on the scale of use of neonicotinoids and other insecticides in common cropping systems in Canada.

V. The value of imidacloprid

PRVD2018-12 refers to the value assessment of the use of neonicotinoid corn and soybean seed treatments, which the PMRA published for consultation in 2016.[35] This assessment evaluated only clothianidin and thiamethoxam seed treatments; nevertheless, the results may be representative of neonicotinoids (including imidacloprid) more broadly. REV 2016-03 concludes that neonicotinoids add limited value to corn and soybean production in Canada

[32] Rondeau, Gary, Francisco Sánchez-Bayo, Henk A. Tennekes, Axel Decourtye, Ricardo Ramírez-Romero, and Nicolas Desneux. "Delayed and Time-Cumulative Toxicity of Imidacloprid in Bees, Ants and Termites." *Scientific Reports* 4, no. 1 (May 2015) http://doi.org/10.1038/srep05566

[33] Alburaki, Mohamed, Sébastien Boutin, Pierre-Luc Mercier, Yves Loublier, Madeleine Chagnon, and Nicolas Derome. "Neonicotinoid-Coated Zea Mays Seeds Indirectly Affect Honeybee Performance and Pathogen Susceptibility in Field Trials." Edited by Cesar Rodriguez-Saona. *PLOS ONE* 10, no. 5 (May 18, 2015): e0125790. https://doi.org/10.1371/journal.pone.0125790.

[34] Alburaki, M., B. Cheaib, L. Quesnel, P.-L. Mercier, M. Chagnon, and N. Derome. "Performance of Honeybee Colonies Located in Neonicotinoid-Treated and Untreated Cornfields in Quebec." *Journal of Applied Entomology* 141, no. 1–2 (February 2017): 112–21. https://doi.org/10.1111/jen.12336.

[35] Health Canada, Pest Management Regulatory Agency, Value Assessment of Corn and Soybean Seed Treatment Use of Clothianidin, Imidacloprid and Thiamethoxam, Re-evaluation Note REV 2016-03, 6 January 2016. Hereinafter REV 2016-03.

(just 3.2 to 3.6 per cent of the national farm gate value for corn, and 1.5 to 2.1 per cent for soybean).

REV2016-03 also refers to the need to seek additional information to finalize the value assessment for both corn and soybean seed treatment stating that: "In order to fully assess the economic value of clothianidin and thiamethoxam seed treatments to the Canadian corn and soybean industries, quantitative, more real-world information on typical pest population levels relative to economic thresholds is needed."[36] PRVD2018-12 makes no mention of any subsequent efforts to address this data gap and also fails to review new evidence, notably the 2018 publication by the Task Force on Systemic Pesticides on alternatives to systemic pesticides.[37]

Other than the reference to REV2016-03 in relation to seed treatments, section 3 of PRVD2018-12 makes only general claims to substantiate the value of imidacloprid – that it is the only insecticide registered to manage specific insect pests or is one of a limited number of alternatives, and that its use in various applications offers growers flexibility. However, the 2018 review by the Task Force on Systemic Pesticides found that the value of neonicotinoids is overrated and diminishing.[38]

The Task Force makes five central points:

- **The use of neonic-treated seeds does not increase crop yields in most cases.** *For example, in a seminal study[39] by Krupke and colleagues, field studies planting treated corn seeds over a three-year period did not benefit yields. This finding is consistent with results of experiments and assessments on oilseed rape in the EU as well as on soybean in the US (as concluded by the USEPA Biological and Economic Analysis Division).[40]*

  This research calls into question the utility of treated seeds. If the economic injury level is not surpassed in most cases, productivity does not drop if seed treatments are withdrawn, and farmer revenues are protected while farmer expenses decrease (assuming treated seeds are sold at a premium).

- **Pest resistance is increasing, reducing the efficacy of neonicotinoids** *Pest resistance has been increasing over the past 2 decades of neonicotinoid use, and insect resistance to insecticides is an inevitable phenomenon that undermines the value of any insecticide.*

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[36] *Ibid*, p.4.
[37] See: Furlan, Lorenzo, Alberto Pozzebon, Carlo Duso, Noa Simon-Delso, Francisco Sánchez-Bayo, Patrice A. Marchand, Filippo Codato, Maarten Bijleveld van Lexmond, and Jean-Marc Bonmatin. "An Update of the Worldwide Integrated Assessment (WIA) on Systemic Insecticides. Part 3: Alternatives to Systemic Insecticides." *Environmental Science and Pollution Research*, February 25, 2018. https://doi.org/10.1007/s11356-017-1052-5.
[38] *Ibid*.
[39] Krupke *et al* 2017, *op. cit.*
[40] USEPA, Biological and Economic Analysis Division. "Benefits of Neonicotinoid Seed Treatments to Soybean Production," October 2014. https://www.epa.gov/sites/production/files/2014-10/documents/benefits_of_neonicotinoid_seed_treatments_to_soybean_production_2.pdf

Since the introduction of clothianidin in 2000, 4 pest insect species (over a total of 40 cases) have been reported to have developed resistance to clothianidin worldwide. Since the introduction of thiamethoxam in 1998, 15 pest insect species (over a total of 205 cases) have been reported to have developed resistance to thiamethoxam worldwide.[41]

- **Early and reliable detection methods to assess the risks of pest presence exist, at low costs**
  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. Based on this, a model was developed in Italy to predict which fields are at high risk of pest problems, in order to appropriately establish a pest management plan. Findings in North-East Italy show 96 per cent of corn fields do not need any insecticide treatment because relevant pest threats are not present above the economic damage level.[42]

- **Effective strategies are available to protect farmers against economic risks and achieve efficient pest control – e.g., the "mutual fund" (MF) model, a novel insurance method designed to protect farmers against crop failure**
  The collective insurance program in Italy is a strong example of a fiscal incentive that supports Integrated Pest Management. Farmers can invest in the insurance program only if they commit to using IPM. The result for farmers is spending of only 10 per cent of expenses previously put towards pesticides now directed towards insurance payments, and farmer revenues are stable or increasing.

- **All scenarios – whether using IPM and/or insurance cover – are cheaper than using neonic-treated seeds**

Together, these findings not only serve to fill the knowledge gap the PMRA refers to in REV2016-03 but more importantly, support the fact that the systematic use of treated seeds in Canada can no longer be defended in value and risk assessments.

Recommendation 13: PMRA should portray more accurately the conclusions of its value assessment for neonicotinoid seed treatments and revise the value assessment for all uses in light of the latest findings of the Task Force on Systemic Pesticides.

Recommendation 14: The PMRA should work with other agencies to support and expand training in IPM and pest assessment techniques, as well as the development of insurance mechanisms, to further reduce risks at the farm level.

[41] Insecticide Resistance Action Committee (IRAC). 2018. Anthropod Pesticide Resistance Database. East Lansing (Michigan, USA): Michigan State University. Access to the database: www.pesticidderesistance.org/search.php
[42] Furlan *et al*, 2018, *op. cit*.

Conclusion

Based on advancing science that reveals significant risks to pollinators from neonicotinoids, global systematic reviews that confirm the availability of cost-effective alternatives to neonicotinoids as well as their limited value/efficacy, and regulatory precedents for bans elsewhere, we call on the PMRA to strengthen the proposed decisions in PRVD2018-12 with an immediate and complete phase-out and deregistration of imidacloprid. We also call on Canada to invest in improved monitoring of pesticides in the environment and impacts.

In sum, the PMRA's proposed risk mitigation strategies in PRVD2018-12 do not go far enough to protect pollinator health and any proposed risk mitigation short of a complete and immediate deregistration of neonicotinoids does not align with the conclusions of the body of peer-reviewed literature on the subject.

Appendix A: List of Recommendations

1. The PMRA should immediately deregister imidacloprid uses/products proposed for phase-out without any further delay.

2. PMRA should revise its risk assessment conclusions to recognize the *overall* risk to pollinators and deregister all outdoor uses.

3. In the absence of a full ban on imidacloprid and other neonicotinoids, PMRA should investigate the effectiveness of label statements in reducing ecological risks and increase capacity to ensure monitoring and compliance.

4. PMRA should more accurately present PRVD2018-12 as a re-evaluation of risks to bees (not all pollinators), and adopt a precautionary approach to protect solitary bees, given their potential for greater exposure and lack of data on effect. Even though the assessments were limited in that they did not consider impacts on all pollinators, the evidence of impacts on honey bees and bumblebees should be significant enough to deregister these pesticides immediately.

5. In the absence of evidence, it cannot be assumed that best management practices are sufficient to reduce neonicotinoid exposures to acceptable levels.

6. If PMRA continues registration of uses on crops that are typically harvested before bloom, as proposed, a label statement should be added prohibiting use on seed crops – even if these crops are not typically grown for seed in Canada at present.

7. PMRA should recognize risks from the cosmetic use of imidacloprid as unacceptable and deregister non-agricultural turf products.

8. PMRA should more thoroughly assess risks to pollinators from imidacloprid tree injections.

9. PMRA should not dismiss the identified risk from residues in wildflowers adjacent to fields planted with imidacloprid-treated seeds and should assess risks from residues in non-target plants (including wildflowers) in connection with foliar applications.

10. The assessment should take into account the contribution of all applications to environmental contamination and resulting risks to pollinators from residues in non-target plants. At a minimum, all foliar uses for which restrictions are proposed to prevent spraying pre-bloom and/or during bloom should be deregistered altogether.

11. PMRA must evaluate the total exposure risk to pollinators from all applications and all uses of imidacloprid, including residues in non-target plants.

12. PMRA should assess additive and cumulative effects on pollinators based on the scale of use of neonicotinoids and other insecticides in common cropping systems in Canada.

13. PMRA should portray more accurately the conclusions of its value assessment for neonicotinoid seed treatments and revise the value assessment for all uses in light of the latest findings of the Task Force on Systemic Pesticides.

14. The PMRA should work with other agencies to support and expand training in IPM and pest assessment techniques, as well as the development of insurance mechanisms, to further reduce risks at the farm level.