Testimony to the Vermont House Committee on Agriculture, Food Resiliency, and Forestry re: H.706 - An act relating to banning the use of neonicotinoid pesticides

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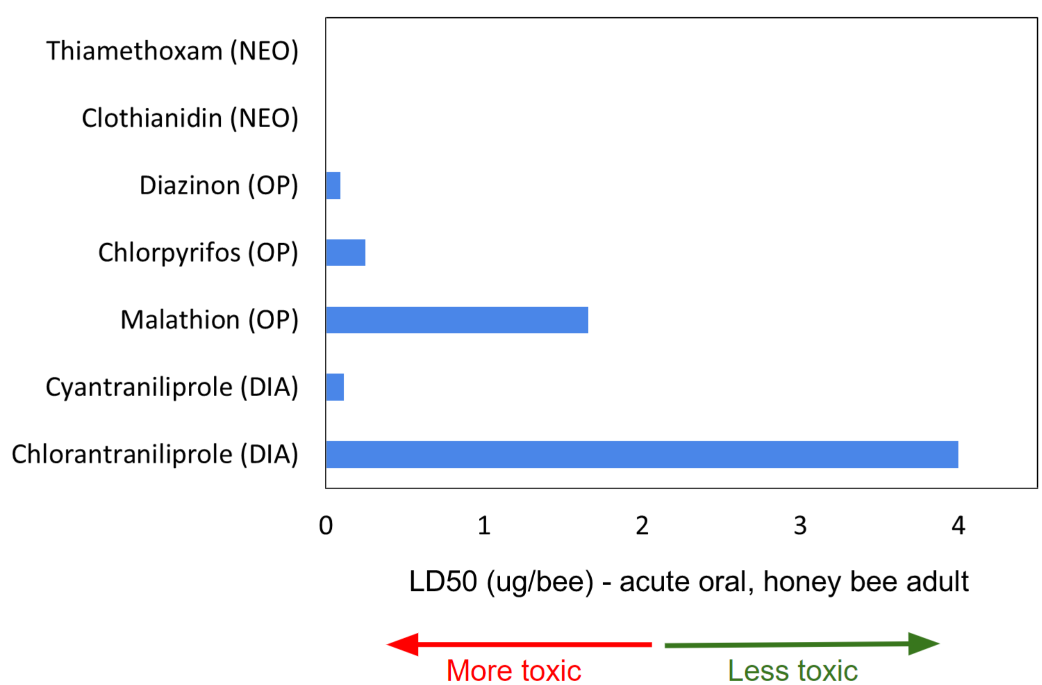
Thank you for the opportunity to testify in support of H.706 on February 14, 2024. I am submitting additional information for the committee's review based on questions that were asked during my testimony.

I. Review of neonicotinoid toxicity compared to other systemic insecticides

The graph I included in my written testimony showed the relative toxicity to bees of a few common systemic insecticides, including two **neonicotinoids** (NEO), two **diamides** (DIA), and two **organophosphates** (OP). Systemic insecticides are those that can be absorbed by a plant and expressed in the plant's tissues (including pollen and nectar). Because they are ingested in pollen and nectar, I based their relative toxicity on oral LD50 values.

A *higher* LD50 means that the chemical is *less* toxic to bees (i.e., a larger dose is required to kill 50% of the test population of honey bees). Conversely, a lower LD50 means the chemical is *more* toxic to adult bees. What we see from this graph is that neonicotinoids are highly toxic to bees at vanishingly small quantities (LD50s much lower than 2 ug/bee).

Figure 1. Acute oral LD50s (in micrograms of active ingredient per adult bee) for a set of common systemic insecticides, including three organophosphates (OP), two diamides (DIA), and two neonicotinoids (NEO). In this case, *lower numbers represent greater toxicity* - the smaller the lethal dose, the more toxic the chemical.



Chair Durfee asked a great question during my testimony: how does the toxicity of **pyrethroid** insecticides, the typical in furrow at-planting treatment for seedcorn maggot and wireworms, compare to the pesticide categories already represented? I used oral LD50s to represent toxicity of the above systemic insecticides because bees consume them via the pollen and nectar of contaminated plants. Pyrethroids, on the other hand, are contact insecticides, which is why I did not include them in this comparison. We address the relative risk of alternative pest control chemicals in the next section.

II. Risk analysis: How do neonic seed treatments compare to alternatives?

In this section, we present information on the relative harm of different pesticides and application methods that can be used against seedcorn maggot and wireworms. We have included:

- Two typical **neonic seed treatment** options for corn in VT (clothianidin, thiamethoxam);
- Two **diamide seed treatment** options (chlorantraniliprole and tetraniliprole);
- One **pyrethroid treatment** that can be applied to seeds in planter boxes; and
- Three **in-furrow at-planting insecticides** labeled for use against seedcorn maggot and wireworms (two pyrethroids and one organophosphate).

Using established methodology[1], we calculated **an index of risk that represents potential harm to honeybees** to compare **per-acre field rates** of neonicotinoid seed treatments against alternative chemical options. The index value accounts for the **toxicity** of the pesticide (LD50), its **application rate** according to the label (in ug per acre), and its **persistence** in the soil after application (half life). We also looked at contact toxicity for the monarch butterfly for the few chemicals for which we have that data. For seed treatments, we assumed a treatment of 1.25 mg of active ingredient per seed[2], a typical seeding rate of 32,000 corn seeds per acre, and a 30" row spacing to calculate total amounts per acre.

Step 1. Based on label application rates, we determined the total amount of active ingredient introduced by each treatment per acre.

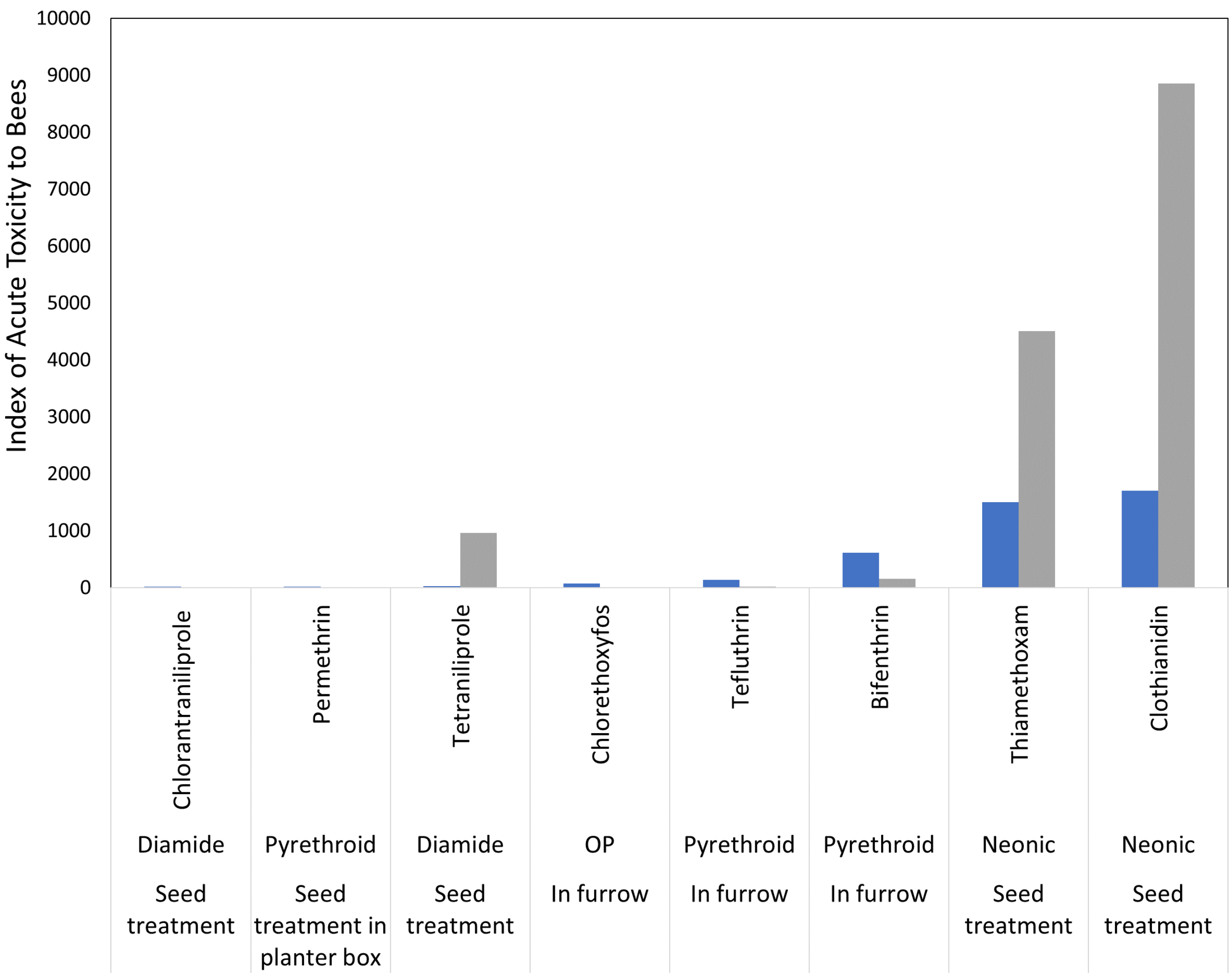
Step 2. We divided this value by the LD50 value for adult honeybees for each treatment. We did this for oral and contact LD50s separately. The LD50 is the amount of active ingredient that is lethal to 50% of a test population of bees. This step yields a theoretical number of bees that can be killed by the amount of active ingredient applied to an acre.

Step 3. We then multiplied this value by the persistence of the chemical in soil (using an exponential decay function based on the number of days it takes for the chemical to break down by half in soil[1]).

[1] We used the methodology from DiBartolomeis et al. (2019) "An Assessment of Acute Insecticide Toxicity Loading (AITL) of Chemical Pesticides Used on Agricultural Land in the United States." PloS One 14 (8): e0220029. https://doi.org/10.1371/journal.pone.0220029

[2] This is the maximum label rate for clothianidin or thiamethoxam on corn seeds, as labeled for corn rootworm (e.g., Cruiser 5FS: https://www.syngenta-us.com/current-label/cruiser_5fs). Some corn seeds are treated at a lower rate (0.25 to 0.8 mg active ingredient per seed), but data on usage of specific seed treatment products/rates in Vermont are not available.

Figure 2. Index of relative harm to bees of different pesticides and application methods that can be used against seedcorn maggot and wireworms. See above for an explanation of the index calculation. Blue bars were calculated using acute contact LD50s for honey bees, and gray bars were calculated using acute oral LD50s for each of the active ingredients. In this case, *<u>larger numbers represent higher risk</u>*.



III. The Risk Analysis Takeaways:

- **Neonicotinoid seed treatments introduce the highest risk per acre** for bees of all of the seed and in-furrow alternatives included for comparison, based on the amount introduced per acre, environmental persistence, and toxicity by both contact and oral exposure.

- **The two neonicotinoid seed treatments were on average 11X more harmful than alternatives by contact exposure, and 29X more harmful than alternatives by oral exposure.** This high level of risk is largely due to the long persistence of neonicotinoids in soil, and the very low dose that it takes to kill a bee in the case of oral exposure. Even when applied at the lowest label rate (0.25 mg ai/seed), neonicotinoid seed treatments were 2.5X more harmful by contact and 6X more harmful by oral exposure than non-neonic alternatives.

- Diamide seed treatments and the pyrethroid insecticide applied directly to seeds at planting introduce less toxicity per acre for bees compared to neonicotinoid seed treatments and in-furrow pesticide applications.

- However, while the **chlorantraniliprole seed treatment** has lower risk potential for bees than the other alternatives, **it is *extremely* toxic to monarch caterpillars**, leading to a very high risk index for diamides for this species. This likely applies to other butterfly larvae as well as other diamide insecticides for which toxicity data does not exist.

Concluding Remarks

Ultimately, any insecticide used for seedcorn maggot and wireworms introduces some level of risk for bees and other pollinators. Some have a greater potential for harm than others, but in the end, the most effective solution is to implement **justified use,** not simply rely on replacement chemicals. Almost all pesticide applications come with some level of environmental cost, which is why we use integrated pest management (IPM) to tolerate acceptable levels of pest pressure, reduce chemical inputs, and justify chemical interventions through scouting, monitoring, and use of economic thresholds. In the case of treated seeds, **we are using insecticides with known environmental cost on nearly 100% of corn acreage in the state with no evidence for a benefit on the vast majority of that acreage.**

Thank you again for your time and consideration of these important issues. Please do not hesitate to reach out with any follow up questions you may have on previous testimony or the information contained in this report.

Sincerely,

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Additional Resources:

- University of Nebraska-Lincoln. Insecticides used to control wireworm and seedcorn maggot.
- https://entomology.unl.edu/insecticides-wireworm-and-seedcorn-maggot-control-corn
- Xerces article about key gaps in EPA's regulatory framework when it comes to accounting for harm to pollinators during pesticide registration, published January 2024. https://www.xerces.org/blog/four-key-gaps-in-pesticide-regulation-for-protecting-pollinators