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Point Of View

A Silent Bzzz: The Need to Improve Methodological Report Clarity for Bee-Related Policy

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Abstract

Bees play a crucial role as pollinators, driving global conservation efforts to protect their diverse species, but how easy can it be to develop new protective and conservationist policies? Established guidelines for bee testing, such as those from the OECD and EPA, already provide guidelines for this task. However, environmental toxicologists and policymakers face significant difficulties in interpreting toxicological data - not due to inherent complexity but rather inconsistent reporting standards that can even obscure critical findings. These challenges highlight the urgent need to revise existing protocols and develop clearer, evidence-based reporting for bee toxicology testing. Addressing these gaps is critical to safeguarding pollinator populations and ensuring ecosystem stability.

Keywords: Bee; Environmental Risk Assessment; guideline; legislation; policy.

Interpreting toxicological data for bees involves navigating multifaceted obstacles rooted in methodological variability, biological complexity, and environmental dynamics. These challenges complicate risk assessments and policy decisions aimed at pollinator protection.

Imagine a newly developed pesticide that has undergone comprehensive ecotoxicological testing across soil, aquatic, and terrestrial ecosystems. It is now your responsibility to compile this information into a report that includes non-human toxicity values, organised in a way that can be readily managed until you reach the data specific to bees. For this purpose, you rely on publications that follow or adapt standard guidelines such as OECD 213 (OECD, 1998a), 214 (OECD, 1998b), 245 (OECD, 2017a), 246 (OECD, 2017b), 247 (OECD, 2017c) or EPA 850.3020 (EPA, 2012a), 850.3030 (EPA, 1996), and 850.3040 (EPA, 2012b). By this stage, the gathered data will cover various exposure routes for bees: oral, topical, and contact exposure. As with other organisms, these different exposure routes yield varying toxicity values that can be managed easily. However, challenges arise when examining the reported data, not due to unit conversions (e.g., ng/mL to µg/mL or ppm to µg/mL), but rather for the inconsistencies in the reporting units even within the same exposure route. These discrepancies complicate direct comparisons and hold back data integration into a cohesive framework for assessing pesticide risks to bees.

But let us take a step back and look at the OECD and EPA guidelines. These guidelines reveal both similarities and crucial differences in their reporting requirements for bee toxicity studies. OECD guidelines request comprehensive dose-response data, including median lethal doses (LD_{50}), concentrations (LC_{50}), daily doses (LDD_{50}), and non-observed effect values (NOEC/NOEDD), all reported with 95% confidence intervals, depending on the specific guideline. For acute toxicity tests (OECD 213 and 214) (OECD, 1998a; OECD, 1998b), "LD_{50} should be expressed in µg of test substance per bee". EPA guidelines, particularly 850.3020, align closely with OECD requirements, requesting LD_{50} values with 95% confidence limits. However, other EPA

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guidelines adopt a more qualitative approach, emphasising descriptive endpoints such as "(…) signs of intoxication and other abnormal behavior, including time of onset, duration, severity, and number affected at each dose level and control". Although some differences are expected between guidelines, these "small-big" differences significantly impact data analysis.

Reporting data for oral exposure in bee toxicity studies can vary significantly depending on the approach used. In some cases, the LD_{50} is provided for a specific time point (e.g., 24h, 72h or 96h) and expressed as µg of active ingredient (a.i.) per bee, calculated based on food consumption during the observation period. Alternatively, the data may be reported as LC_{50} in µg a.i./mL or ppm, reflecting the chemical concentration in the provided food. However, when food consumption is not reported in this second approach, it becomes impossible to convert LC_{50} values into µg a.i./bee. Additionally, some studies report toxicity as µg a.i./bee/day without including critical information such as food consumption or the number of live and dead bees at each sampling point, despite these details being explicitly requested in the guidelines. Similar challenges happen with topical exposure tests, where a 1 µL droplet of pesticide is applied to the thorax of bees. In this case, µg/µL can be compared to µg/bee since only one droplet is applied per bee. However, it is also common to encounter surface doses expressed as ng/cm² or body weight-normalised values in µg/mg of bee. Converting these metrics becomes problematic if the weight of the bees is not reported, which is often the case. Contact exposure presents additional complexities related to the mode of exposure. Bees may be directly sprayed with the pesticide solution or indirectly exposed by being placed on a surface (e.g., filter paper) that has been previously sprayed with the chemical. The standard reporting metric for both OECD and EPA guidelines is µg/cm², yet field studies frequently use g/ha to describe application rates without correlating surface residues to individual bee exposure levels. Moreover, contact exposure data are sometimes reported in µg/mL based on the concentration of the chemical concentration, further complicating comparisons across studies. These inconsistencies in reporting metrics across oral, topical, and contact exposure routes highlight significant gaps in standardisation. Without critical supporting information such as food consumption rates, bee weights, or residue correlations, converting and interpreting toxicity data becomes challenging and limits its utility for risk assessment and regulatory decision-making.

To address these challenges, regulatory bodies should consider revising their guidelines to incorporate weight-normalised metrics and mandate the full disclosure of measure parameters, such as food consumption, bee weight, and other critical variables mentioned earlier (Fig. 1). Adopting normalised metrics, such as µg a.i./mg bee, would facilitate cross-species comparisons and allow a more precise determination of regulatory thresholds. As so, researchers should report all variables, including food consumption, bee weight, and number of live/dead bees at every sampling point to allow for full unit conversion.

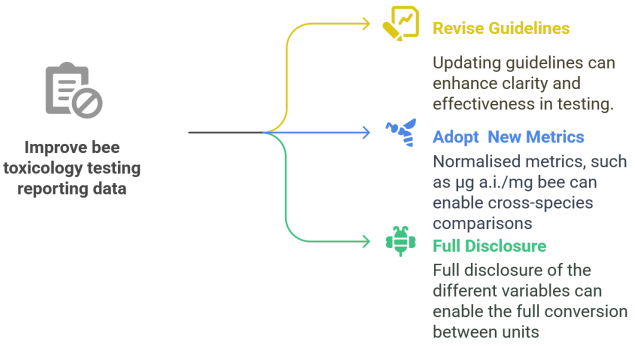

Figure 1. Suggestions of measures to be adopted to improve reporting data from toxicological testing.

Meanwhile, requiring the comprehensive reporting of all relevant variables would enable smooth conversion between units, giving users the flexibility to select the format that best suits their analysis needs. These changes would enhance the consistency and utility of toxicity data, ultimately improving its applicability in risk assessments and regulatory decision-making. These changes could even be incorporated into the new draft for the OECD guideline acute contact toxicity test with *Osmia sp.* (OECD, 2025), which is currently under a commenting round.

The complex challenges associated with interpreting bee toxicological data highlight a critical gap between standardised testing protocols and ecologically relevant risk assessments. Although OECD and EPA guidelines offer vital frameworks for measuring acute toxicity, ongoing inconsistencies in reporting metrics hold back the effective translation of laboratory findings into practical conservation strategies. To bridge this gap, Systemic reforms are necessary to transform fragmented datasets into a cohesive foundation for protecting pollinators and preserving the ecosystems and agricultural systems that rely on their indispensable services.

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NGCF: Conceptualisation, Investigation, Writing – original draft; **CT:** Conceptualisation, Investigation, Writing – original draft.

COMPETING INTERESTS

The authors declare that they have no competing interests.

REFERENCES

EPA (1996) Ecological Effects Test Guidelines OPPTS 850.3030 Honey Bee Toxicity of Residues on Foliage. EPA.gov https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100XGV5.txt

EPA (2012a) Ecological Effects Test Guidelines OCSPP 850.3020: Honey Bee Acute Contact Toxicity Test. EPA.gov https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100IRFL.txt

EPA (2012b) Ecological Effects Test Guidelines OCSPP 850.3040: Field Testing for Pollinators. EPA.gov https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100IRF2.txt

OECD (1998a) Test No. 213: Honeybees, Acute Oral Toxicity Test, OECD Guidelines for the Testing of Chemicals, Section 2, OECD Publishing, Paris. doi:10.1787/9789264070165-en.

OECD (1998b) Test No. 214: Honeybees, Acute Contact Toxicity Test, OECD Guidelines for the Testing of Chemicals, Section 2, OECD Publishing, Paris. doi:10.1787/9789264070189-en.

OECD (2017a) Test No. 245: Honey Bee *(Apis mellifera* L.), Chronic Oral Toxicity Test (10-Day Feeding), OECD Guidelines for the Testing of Chemicals, Section 2, OECD Publishing, Paris. doi:10.1787/9789264284081-en.

OECD (2017b) Test No. 246: Bumblebee, Acute Contact Toxicity Test, OECD Guidelines for the Testing of Chemicals, Section 2, OECD Publishing, Paris. doi:10.1787/9789264284104-en.

OECD (2017c) Test No. 247: Bumblebee, Acute Oral Toxicity Test, OECD Guidelines for the Testing of Chemicals, Section 2, OECD Publishing, Paris, https://doi.org/10.1787/9789264284128-en.

OECD (2025) Mason bees (*Osmia sp.*), acute contact toxicity test (draft). OECD Publishing, Paris. https://www.oecd.org/en/events/public-consultations/2024/12/first-commenting-round-draft-new-test-guideline-describing-the-mason-bees-osmia-sp-acute-contact-toxicity-test.html