Realistic Field Exposure - Pilot Study on Refining Bee Exposure Residue Data: Comparative Analysis of Field and Tunnel Studies for Phacelia Crops

Pierre Mack, Farnaz Faramarzi, Silvio Knaebe

Eurofins Agroscience Services Ecotox GmbH Eutinger Str. 24, 75223 Niefern-Oeschelbronn, Germany
[1] E-mail contact: PierreMack@eurofins.com

Introduction

Bees are essential pollinators, and it's crucial to ensure that pesticides used in agriculture don't harm them. Currently, pesticide risk assessments for bees often rely on "worst-case scenario" data, which may overestimate the actual risk. To address this, the European Food Safety Authority (EFSA) has proposed new guidelines (EFSA2023) that allow for more realistic exposure estimates.

EFSA2023 outlines two main approaches for conducting bee field studies:

1. Minimum Alternative Forage Studies: These studies aim to create a worst-case exposure scenario by ensuring that less than 10% of the landscape within a 4 km radius of the study fields contains alternative forage resources. This setup ensures bees forage almost exclusively on the treated crop, maximizing residue exposure measurements in pollen and nectar.
2. Randomly Selected Landscape Studies: These studies are designed to represent realistic field conditions by selecting 15 locations across the intended area of pesticide use. Bees are exposed to treated crops within diverse landscapes, including natural forage, to measure residues under typical foraging conditions while maintaining statistical reliability of data

Despite this proposal as a refinement option, these approaches have not yet been implemented in practice.

Methods

To gain some practical aspects and estimate realistic reductions in residues when transitioning from worst-case tunnel data to real-life field conditions we conducted a small Pilot Project.

Our study compares residue data in pollen from two distinct settings:

- **Field Set-up**: Residues were measured at four Phacelia field sites.
- **Tunnel Set-up**: Residues were measured at two enclosed Phacelia tunnels.

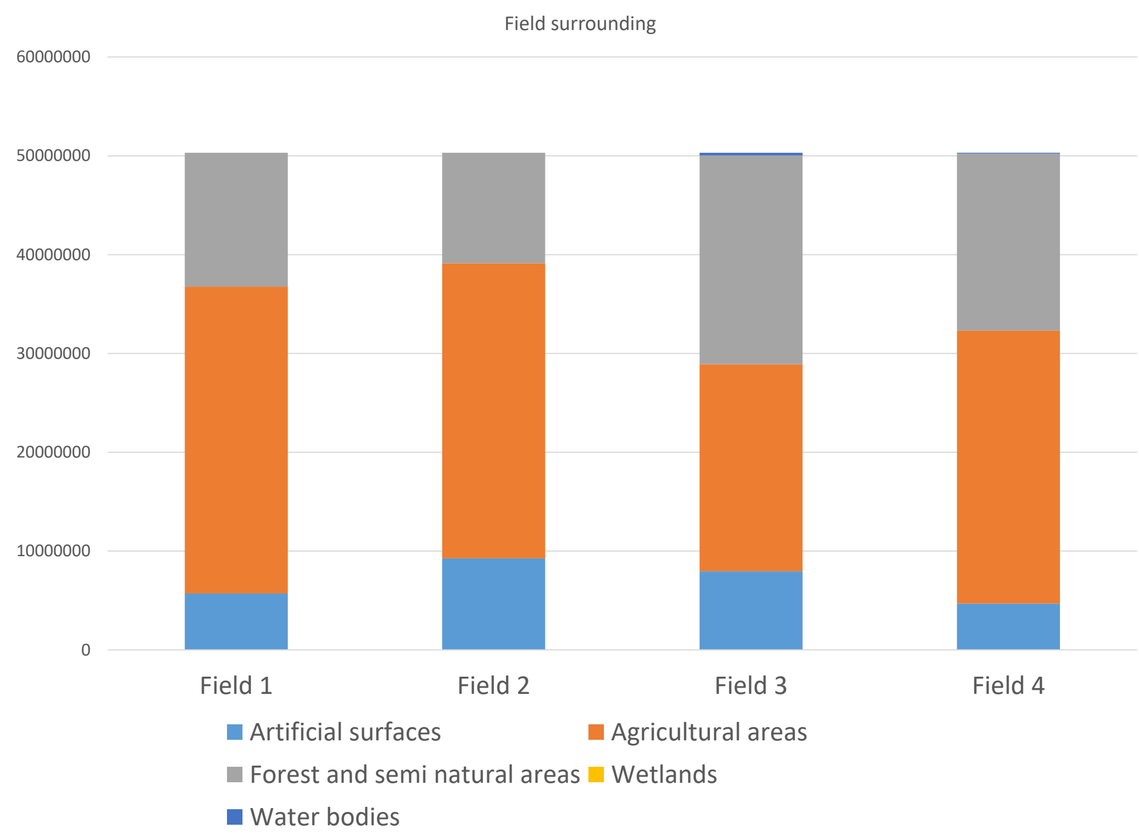
All sites were applied at the same rate of a commercial pesticide and samplings took place at 3 different sampling intervals at 0, 1 and 3 days after the respective application. In total, we generated 10 residue values in the field and 6 values in the tunnels.

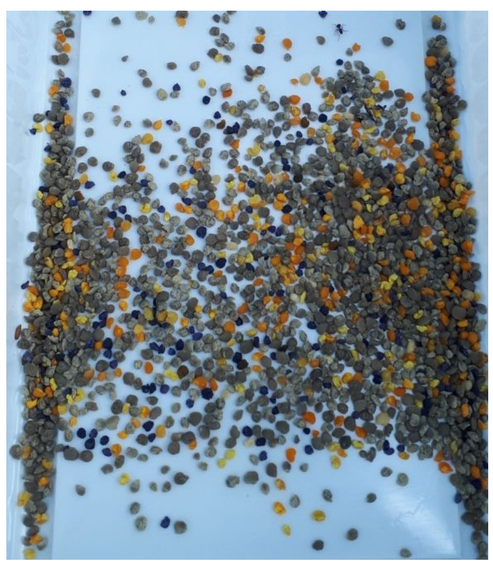
Results

Residues in the field were reduced by more than 80% compared to the tunnel.

source	Replicate	timing (DAA)	Residue Value (mg/kg)
field	1	1	0.0430
		3	0.0677
	2	0	0.160
		1	0.0488
		3	0.0164
	3	0	0.00844
		1	< LOD
		3	< LOD
	4	1	< LOD
		3	0.00361
tunnel	1	0	1.85
		1	0.187
		3	0.0730
	2	0	1.96
		1	0.106
		3	0.442

timing (DAA)	Mean Residue Value (mg/kg)		Reduction in %
	tunnel	field	
0	1.905	0.084	-95.6
1	0.147	0.024	-83.3
3	0.258	0.023	-91.2
total	0.770	0.036	-95.4





Pollen sample from pollen trap

Discussion and Conclusions

- **Clear Dilution Effect:** This pilot study demonstrates a dramatic reduction (>80-95%) in pesticide residues in pollen when moving from confined tunnel conditions to realistic open field settings.
- **Mechanism:** Findings support the hypothesis that real-world environmental factors, such as the availability of diverse alternative forage and landscape variability, dilute pesticide exposure for foraging bees.
- **Risk Assessment Impact:** The significant difference observed suggests that standard worst-case tunnel studies may substantially overestimate the actual risk of pesticide exposure faced by bees in many field situations.
- **Supporting EFSA 2023:** These results underscore the importance and validity of incorporating realistic field exposure data, as advocated in the EFSA 2023 guidance , for more accurate bee risk assessments.
- **Future Work Needed:** Further research is essential to investigate how the degree of residue dilution varies across different agricultural landscapes with varying complexity and forage availability.

Take-Home Message: Studying realistic field exposure appears to be a viable and necessary pathway for refining bee risk assessments, potentially leading to more accurate and proportionate protective measures.

References

EFSA 2023. Revised guidance on the risk assessment of plant protection products on bees (Apis mellifera, Bombus spp. and solitary bees). EFSA Journal 2023;21(5):7989