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The widely managed pollinator honey bee (*Apis mellifera*) is crucial for crop fertilization. Recent studies show increased bee colony mortality rate due to anthropogenic activities (agricultural land use) and greater use for plant protection products. Our study investigated pesticide residues in pollen samples collected by honey bees, and how the landscape composition and seasonality influenced pollen contamination. In 2023, six apiaries have been selected from different Latvian landscapes (semi-natural habitats, agricultural habitats, urban environment). We carefully collected pollen samples throughout the flowering season (2023). 39 pollen samples were analyzed, of which 21 samples contained 93 pesticide residues (mainly fungicides), with values above the limit of quantification. The most frequently residues in the pollen samples were acetamiprid (28 times detected), boscalid (10), fluopyram and prothioconazole (8). The highest concentrations were detected for dimoxystrobin (44 µg kg⁻¹), acetamiprid (37 µg kg⁻¹), azoxystrobin (27 µg kg⁻¹), prothioconazole (25 µg kg⁻¹) and boscalid (15 µg kg⁻¹). The calculation of the Pollen Hazard Quotient (PHQ) was conducted for the each pollen sample. No pollen sample tested exceeded the PHQ value of 50. Highest cumulative PHQ value of 3.621 was observed in the first half of the growing season (29.05.-11.06.), after which the PHQ value decreased significantly. To assess the effect of agricultural land cover on PHQ, a linear regression analysis was performed using agricultural land cover (%) within a three kilometer radius as a factor and PHQ values as the response variable. A significant strong positive correlation ($r = 0.67$, $p = 0.05$) was calculated between the proportion of Brassicaceae pollen and the concentration of acetamiprid in the samples, confirming that honeybees mainly collected pollen from flowering fields of oilseed rape. There was no statistically significant relationship between PHQ and landscape composition ($\beta = 0.06$; $p = 0.07$). The increase in the proportion of agricultural land within the landscape was not found to correlate with higher levels of pollen residue and increased PHQ values. The present study demonstrates that a low proportion of agricultural land in the landscape does not ensure that honey bees can avoid coming into contact with pesticides while gathering pollen and nectar.

Presence of pesticide residues in honey-bee-collected pollen in the context of Latvian landscapes

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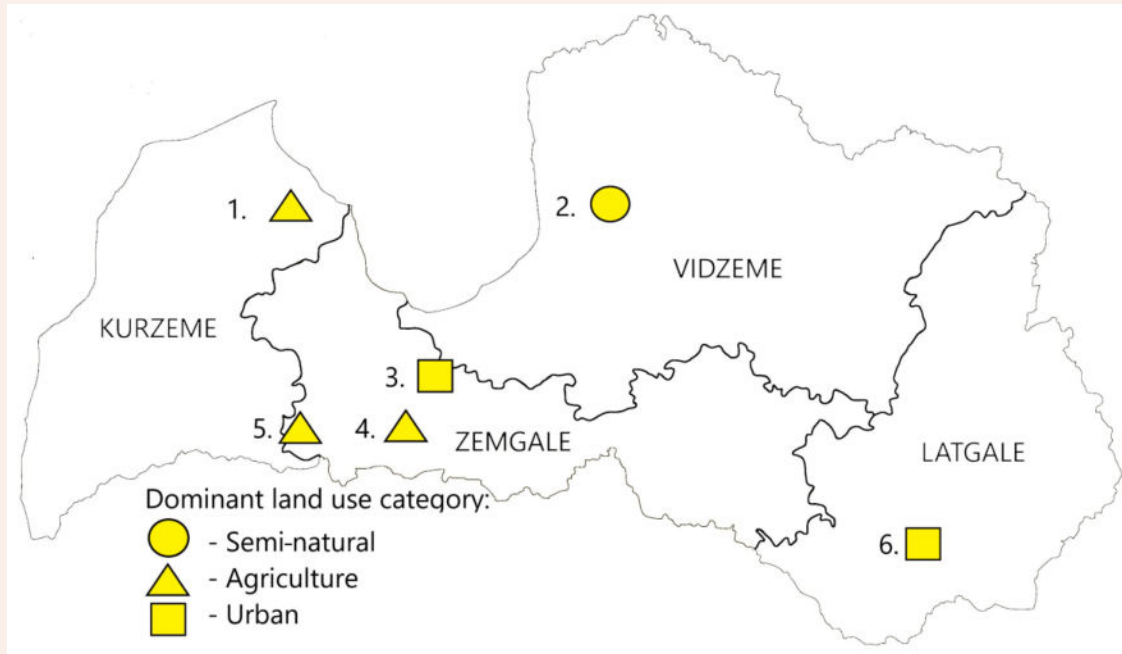
Why This Study?

- Honey bees (*Apis mellifera*) are vital pollinators, yet colony losses are increasing.
- Pesticides and land-use changes are key stressors.
- Few studies in Baltic landscapes—Latvia as a case study.
- Aim: investigate pesticide residues in bee pollen across Latvian landscapes and seasonality influence on pollen contamination.



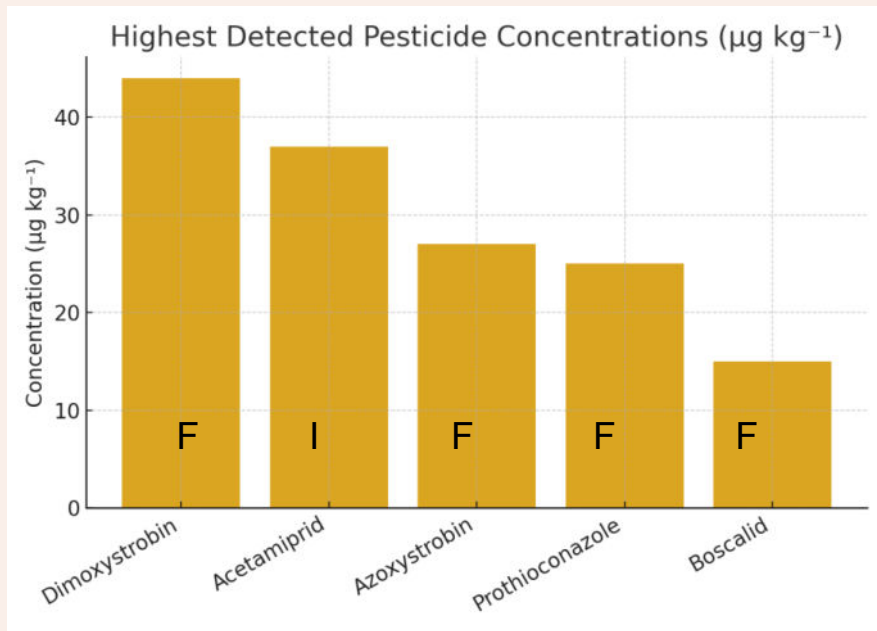
Study Design

- 6 apiaries across Latvia (semi-natural, agricultural, urban).
- Pollen samples collected throughout 2023 flowering season.
- 39 samples analyzed for pesticide residues.
- Compared contamination with land cover within 3 km radius.



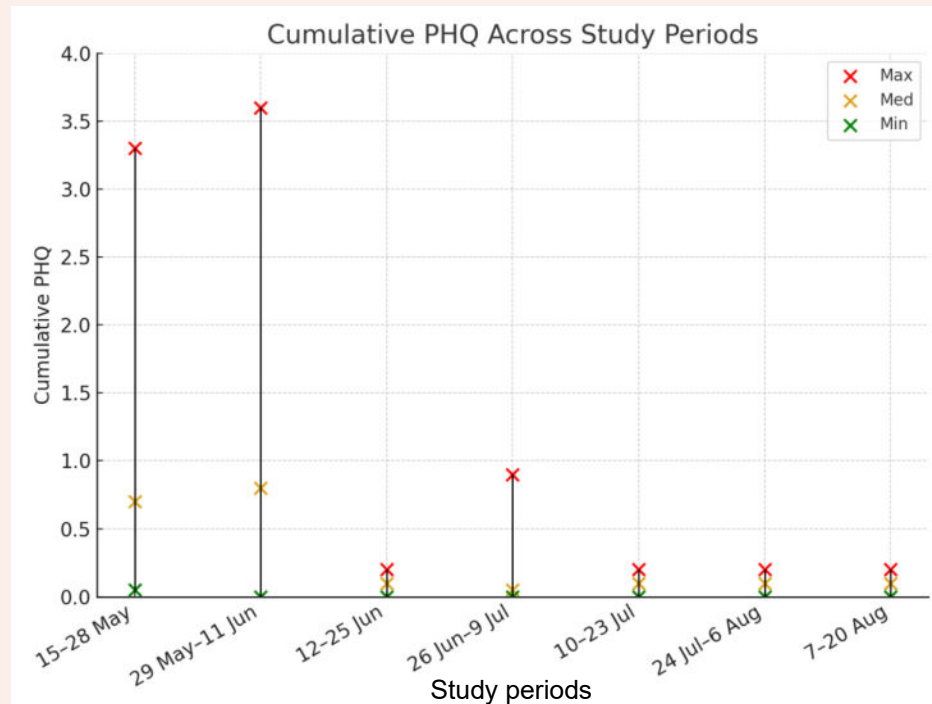
Key Findings (1/3)

- 21 of 39 samples contained residues above detection limits.
- 93 total residues detected, mainly fungicides.
- Most frequent residues: acetamiprid (28 detections), boscalid (10), fluopyram (8), prothioconazole (8).
- Highest concentrations observed:
 - Dimoxystrobin ($44 \mu\text{g kg}^{-1}$)
 - Acetamiprid ($37 \mu\text{g kg}^{-1}$)
 - Azoxystrobin ($27 \mu\text{g kg}^{-1}$)
 - Prothioconazole ($25 \mu\text{g kg}^{-1}$)
 - Boscalid ($15 \mu\text{g kg}^{-1}$)



Key Findings (2/3)

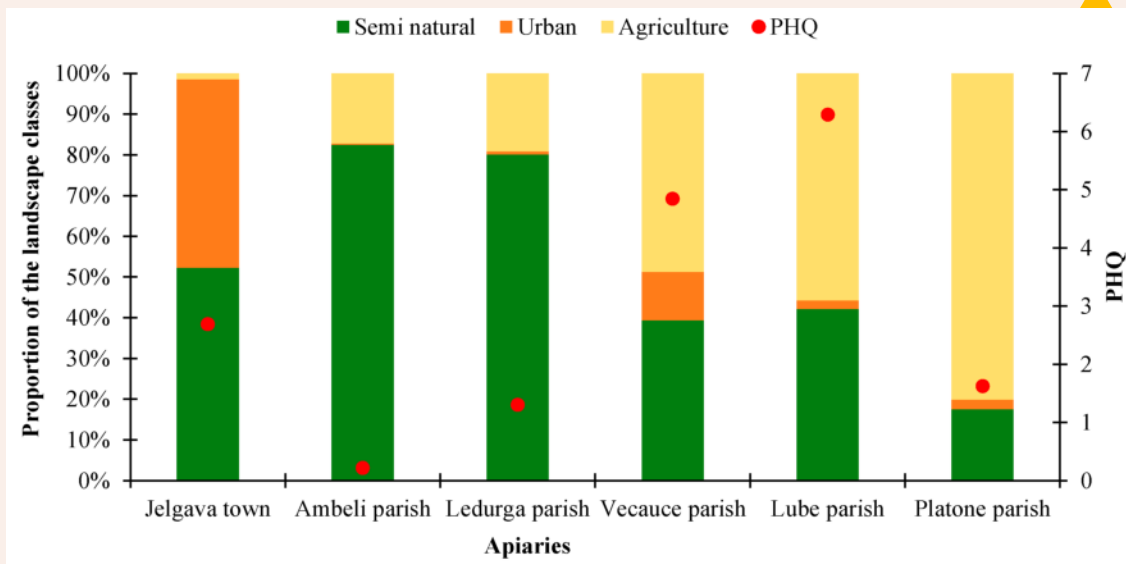
- Pollen Hazard Quotient (PHQ): below critical threshold (50) – safe zone.
- Seasonal pattern: contamination peaked in May–June (29.05.-11.06.), PHQ values of 3.621.
- Decline later in vegetation season.



Variation of the cumulative Pollen Hazard Quotient (PHQ) in the studied honey bee apiaries in 2023

Key Findings (3/3)

- Landscape composition had no significant effect ($\beta=0.06$; $p=0.07$), but close!!
- *Brassicaceae* (crucifers) pollen correlated ($r=0.67$, $p=0.05$) with higher acetamiprid.
- Bees mainly foraged on oilseed rape fields.



Cumulative PHQ values and the landscape composition within a 3 km radius for each apiary in 2023



What This Means for Beekeepers

- Colonies not at acute risk, but chronic exposure possible.
- Early-season residues overlap with colony buildup → hidden risks.
- Landscape not predictive: pesticide drift exposure is widespread.
- Crop-specific exposure (e.g., oilseed rape) important.
- Bees cannot avoid pesticides, even in semi-natural or urban areas.
- Beekeepers should monitor early flowering season.



Take-Home Messages

- Widespread but sub-critical pesticide residues.
- Seasonal peaks (May–June) critical for colony health - more important than land type.
- Landscape type does not predict contamination.
- Even non-agricultural areas show residues.
- Oilseed rape = major source of acetamiprid exposure.
- Beekeepers and regulators should pay close attention to the early season.





Acknowledgments & Contact

Thanks to Latvian beekeepers & research institutions.
QR code to full study:

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Thank you! Questions welcome.



CREDITS: This presentation template
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