Pesticide residues in pollen collected by honeybees

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Ministère de l'Agriculture, de la Viticulture et du Développement rural

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Original purpose(s) of the study

1. **Identification of pesticide residues that may be related with colony losses**

2. **Description of the pesticide load in pollen over time (monitoring element of the *Plan d'action national de réduction des produits phytopharmaceutiques*)**

What exactly is pollen?

Pollen is a powder, produced by the male part of a flower, that causes the female part of the same type of flower to produce seeds. It is carried by insects or the wind.

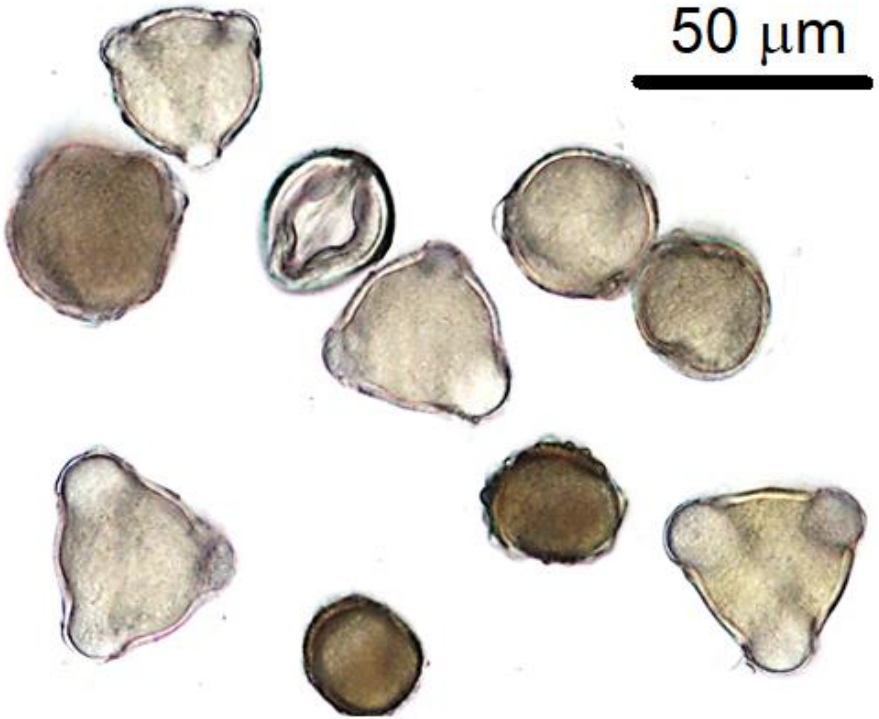

Photo: Clermont

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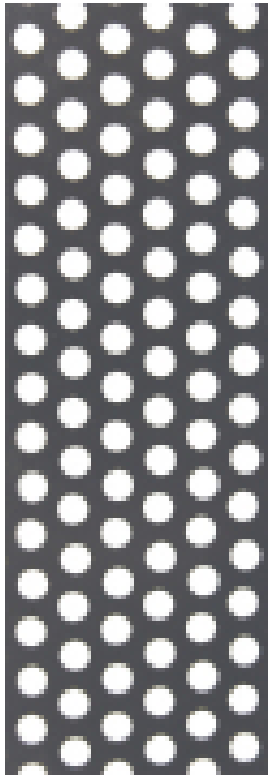
How can pollen be collecte



Photos: Beyer

Why do bees collect pollen?

The bee diet

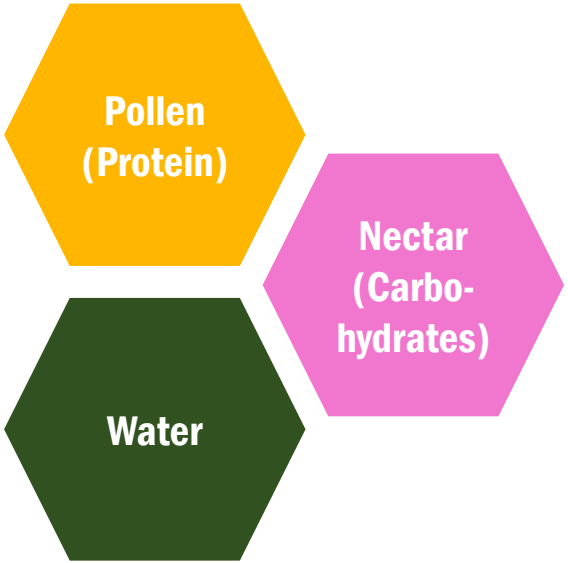


Photo: Beyer

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Why consume pollen?

Claimed benefits of consuming pollen

- Broad nutritional profile with +250 active substances
- High antioxidant content
- May lower risk of high blood lipids and cholesterol
- May boost liver function / protect from toxic substances
- Anti-inflammatory properties
- May boost immunity & kill bacteria
- May support wound healing & prevent infections
- May have anti-cancer properties
- May ease menopausal symptoms

How much pollen consumption is advertised?

¼ teaspoon up to 2 tablespoons / day

⇒ Rather low quantity compared with other food commodities

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So far for the potential benefits . . .

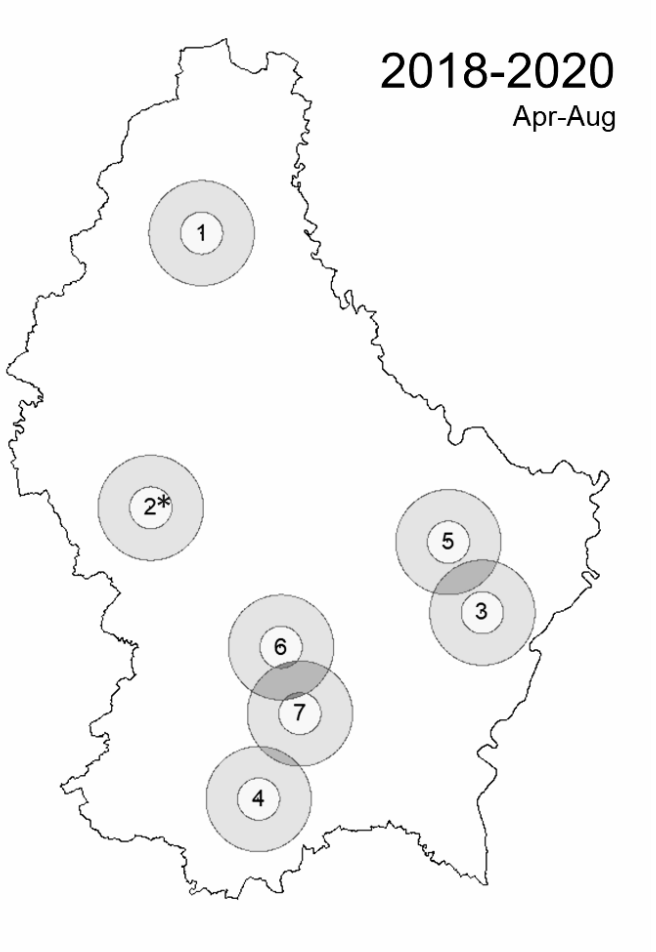
…now let's have a look at one of the downsides

Photo: Eickermann

Pollen is a commodity that is particularly prone to get in contact with pesticides

Pollen samplin

The locations



*2018-2019

Circles indicate 5 km radii that correspond approximately with the flight range of honey bees.

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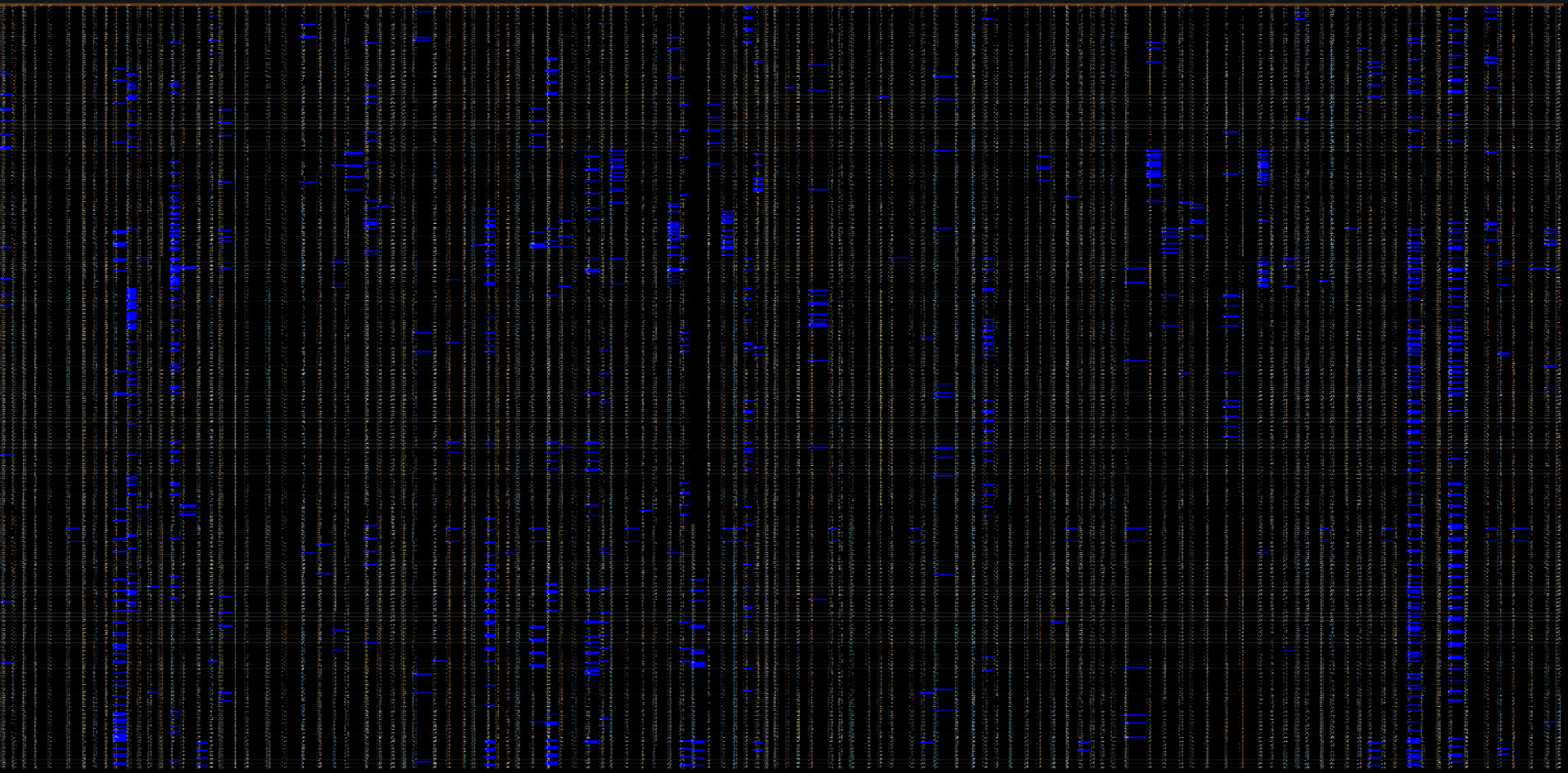
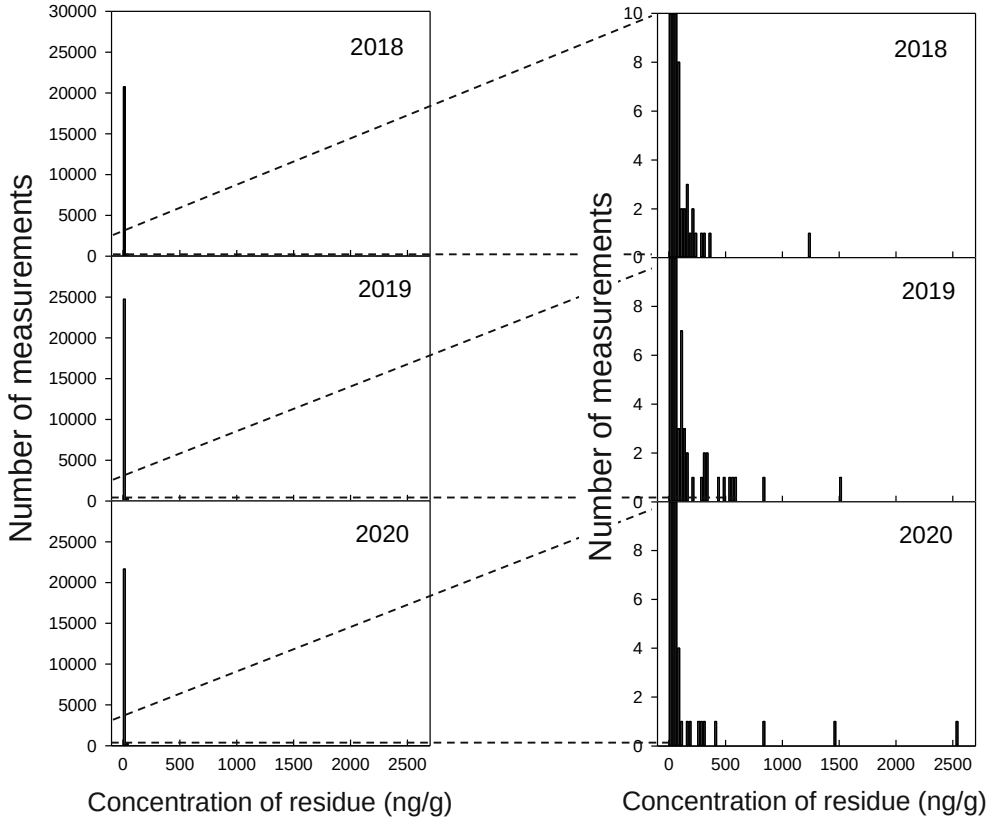
Methods

- **Pollen was collected by honey bees**
- **Local bee keepers handed the pollen samples to LIST**
- **Time frame: April until August, years 2018-2020**
- **4 colonies per location, 6 (2020)-7 (2018, 2019) locations, 2 samples per month**
- **Analytical chemistry at LIST: 115 (in 2020 116) active ingredients or their degradation products**

115 (in 2020 116) compounds x 592 samples ¦ positives are blue



Frequency of the positives (detected residues) 2018-2020



Measurements: 21045
Positives: 285 (= 1.35%)

Measurements : 25185
Positives: 448 (= 1.78%)

Measurements : 22040
Positives: 376 (= 1.71%)

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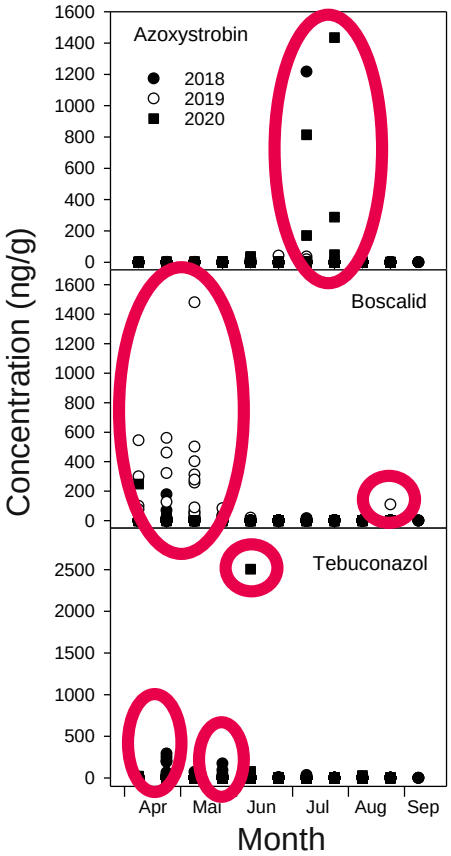
What was found?

Compounds that were found in more than 5% of the samples

Table 1: Active ingredients of pesticides that were found in pollen samples from Luxembourg over the period 2018–2020. A total of 592 bee pollen samples from 7 apiaries were analyzed. For all compounds that were found only once, the concentration is given between the min and max columns.

Compound	No. of positive samples	% of analyzed samples	Concentration range in positive samples (ng/g)		
			Min	*Max*	
Tebuconazole	114	19.3	0.95	2504.90	➢ Fungicide
Thiacloprid	103	17.4	0.29	179.94	➢ Insecticide, banned in the meantime
Boscalid	77	13.0	0.81	1480.31	➢ Fungicide
DCBA (2,6-Dichlorobenzamide)	74	12.5	0.26	4.55	➢ Degradation product of a herbicide
Azoxystrobin	63	10.6	0.42	1435.69	➢ Fungicide
DET (Desethylterbuthylazine)	62	10.5	0.40	3.70	➢ Degradation product of a herbicide
Diflufenican	39	6.6	0.32	17.62	➢ Herbicide
Flutolanil	38	6.4	0.88	13.40	➢ Fungicide
Epoxiconazole	35	5.9	1.18	39.23	➢ Fungicide, banned in the meantime
Methiocarb	32	5.4	0.96	11.43	➢ Insecticide

When were high concentrations found?



Azoxystrobin

4 x 2020

1 x 2018

⇒ Vast temporal fluctuations

Boscalid

3 x 2018

18 x 2019

1x 2020

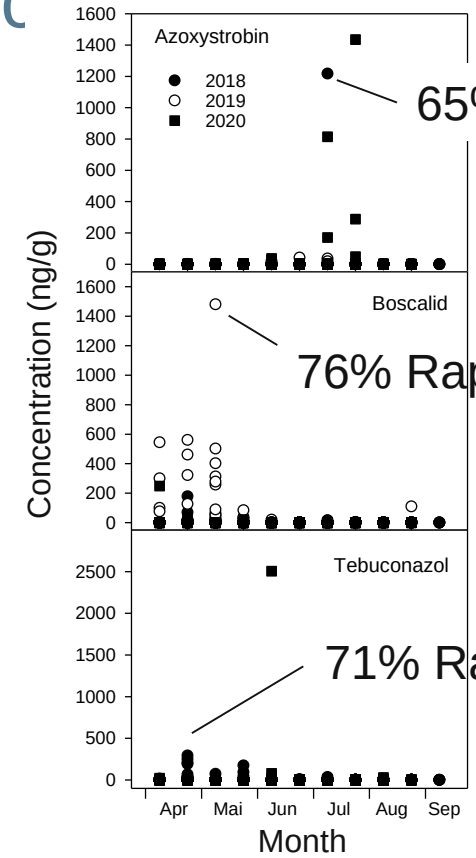
⇒ Focus on specific months and years

Tebuconazol

8 x 2018

2 x 2020

What was the putative origin of the high concentrations?



65% Asparagus pollen

76% Rapeseed

71% Rapeseed

Bild: Beyer

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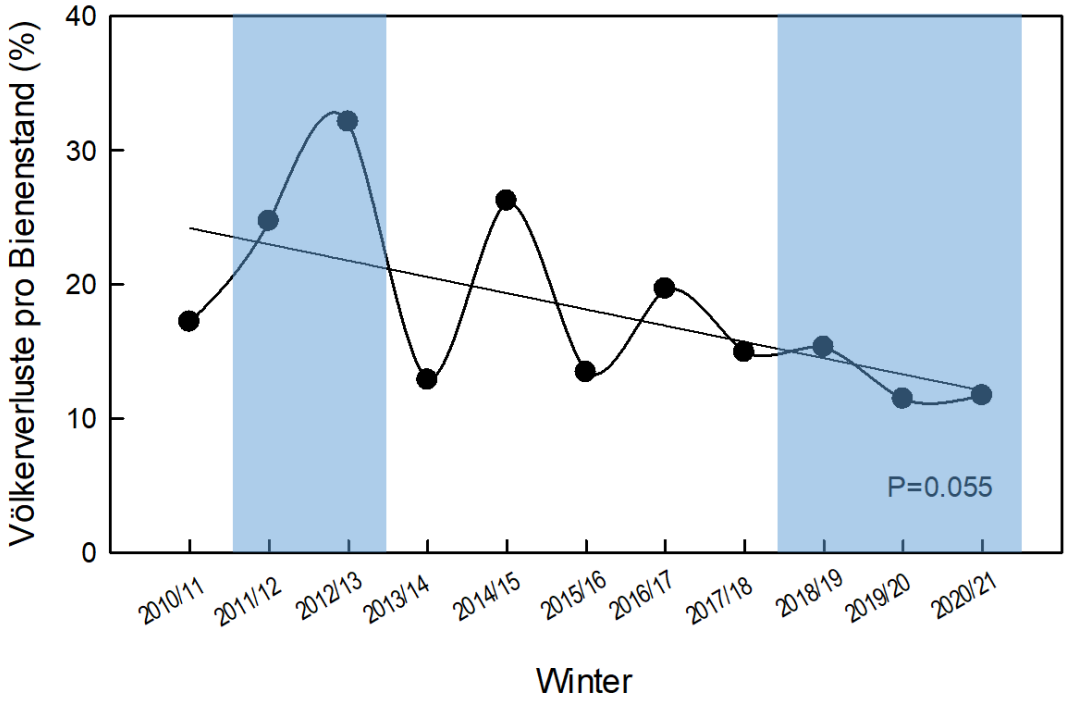
Dangerous for bees ?



Average winter colony losses (%) per apiary in Luxembourg between 2010/11 and 202/21 – the national level.

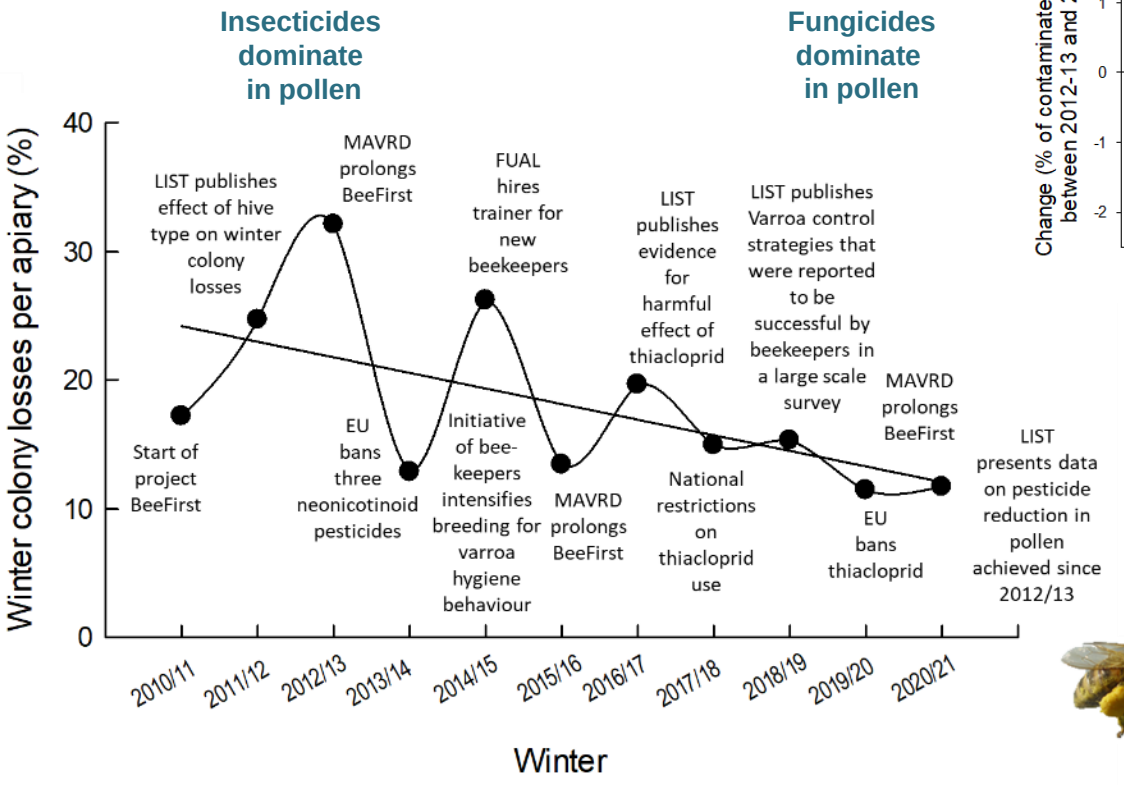
Dangerous for bees ?

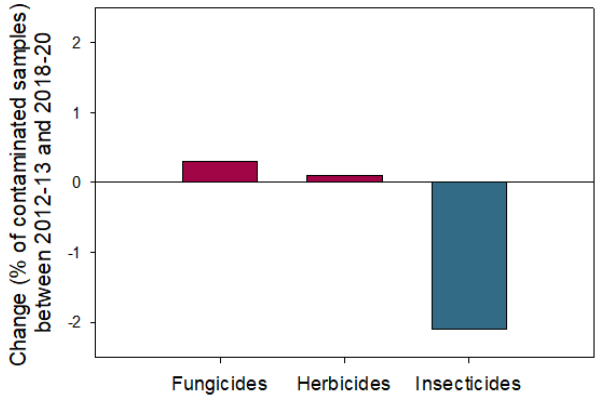
Among the experimental colonies where pollen was sampled, the relationship between colony losses and pesticide residues was significant at $P = 0.02$ in 2012/13.

Using the same methods, this was not the case in 2018-20 anymore ($P = 0.26$).

How is that possible?

Dangerous for bees ?





Abbreviations:

EU – European Union
LIST – Luxembourg Institute of Science and Technology
FUAL - Féderation des unions des apiculteurs de Luxembourg
MAVRD – Ministry of Agriculture, Viticulture and Rural Development

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Summary

Winter colony losses of honeybees averaged 28 ± 4% per apiary in the period 2012-2013 and 14 ± 2% in the period 2018-2020

In 2012-2013, a statistic relationship between pesticide residues in pollen and colony losses could be demonstrated, which was not the case in 2018-2020 anymore.

In 2012-2013, the pesticide residue mix in pollen was dominated by insecticides; in 2018-2020 it was dominated by fungicides.

The current data suggest that the pesticide residue mix in pollen became less risky for honeybees between 2012-13 and 2018-20.

Reference

Beyer M, Lenouvel A, Guignard C, Eickermann M, Clermont A, Kraus F, Hoffmann L (2018): Pesticide residue profiles in bee bread and pollen samples and the survival of honeybee colonies—a case study from Luxembourg. Environmental Science and Pollution Research 25: 32163–32177. https://doi.org/10.1007/s11356-018-3187-4

Acknowledgements

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thank you

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