

Guttation as an exposure route in the risk assessment for plant protection products – Review of the available data



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Introduction

Guttation

- Phenomenon in vascular plants
- Occurrence under high humidity and low transpiration (night, early morning) in order to maintain xylem flow
- Depending on plant species and growth stages



Residues in guttation water

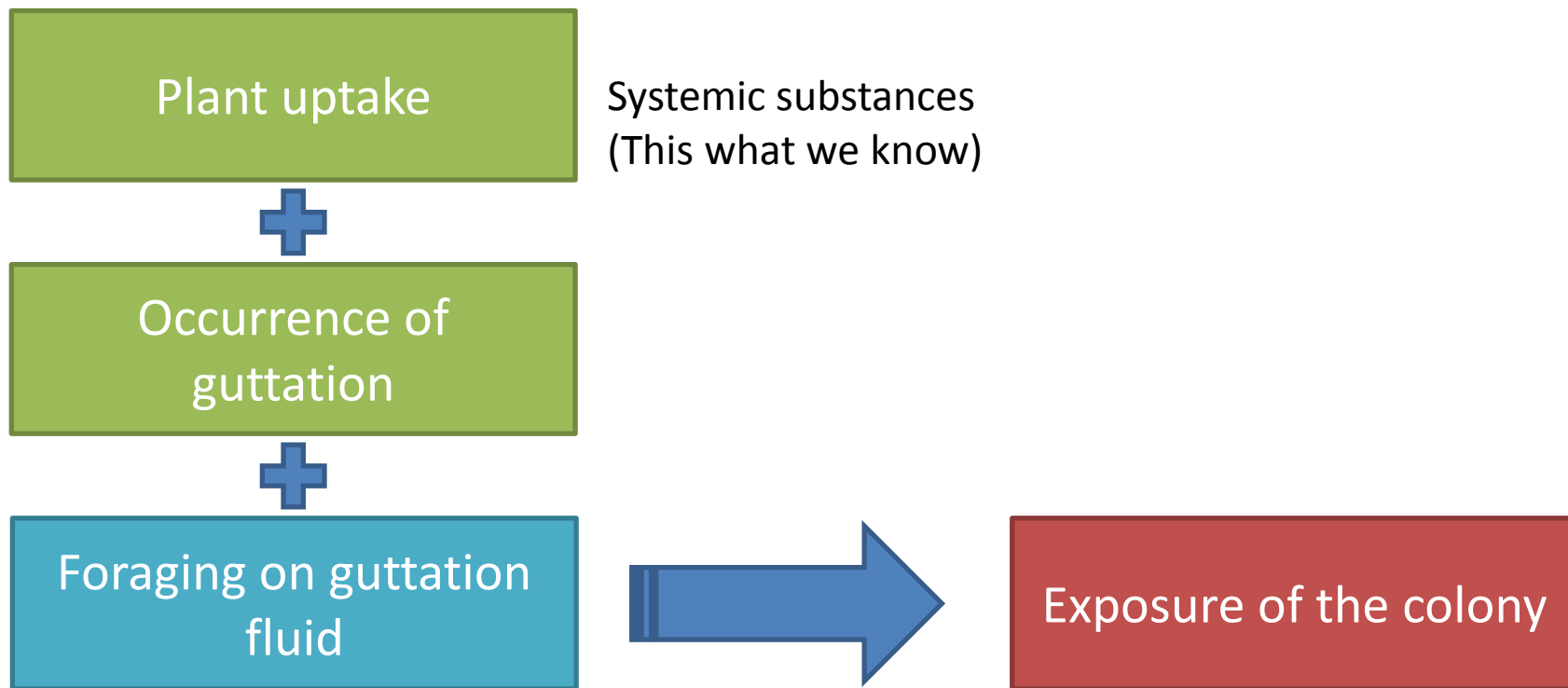
- Systemic Plant Protection Products (PPP) can be detected in guttation droplets.
- Reviews by Schmolke et al. (2018) and Pistorius et al. (2012).

Water foraging honey bees

- Water is needed for the dilution of honey (spring) or for the cooling of the hive (summer).
- No constant demand for water (**demand-driven**).
- Demand for nectar and pollen in spring and summer constant (**supply-driven**).

Exposure

1. The amount of residues in guttation water after PPP application.
2. The occurrence of guttation on a certain plant species.
3. The extent to which honey bees are actually foraging on guttation droplets.



Aims

- Review of available studies for regulatory purposes (industry studies).
- 90th percentile estimate for the occurrence of guttation and foraging of honey bees on guttation fluid.

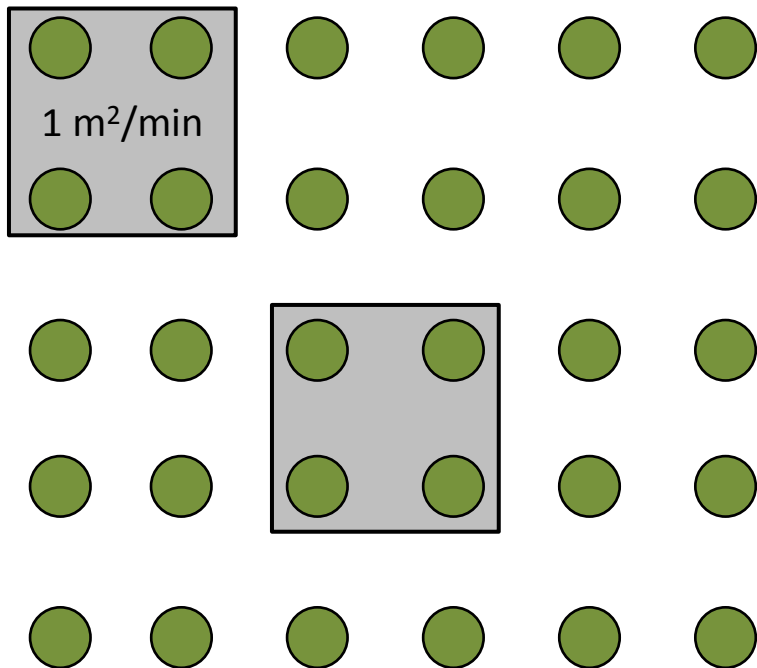
Industry studies

- 25 Studies
- FR, DE, NL
- Honey bee colonies placed near treated maize, sugar beets, OSR, cereals.
- Effect studies containing information on mortality and colony strength.

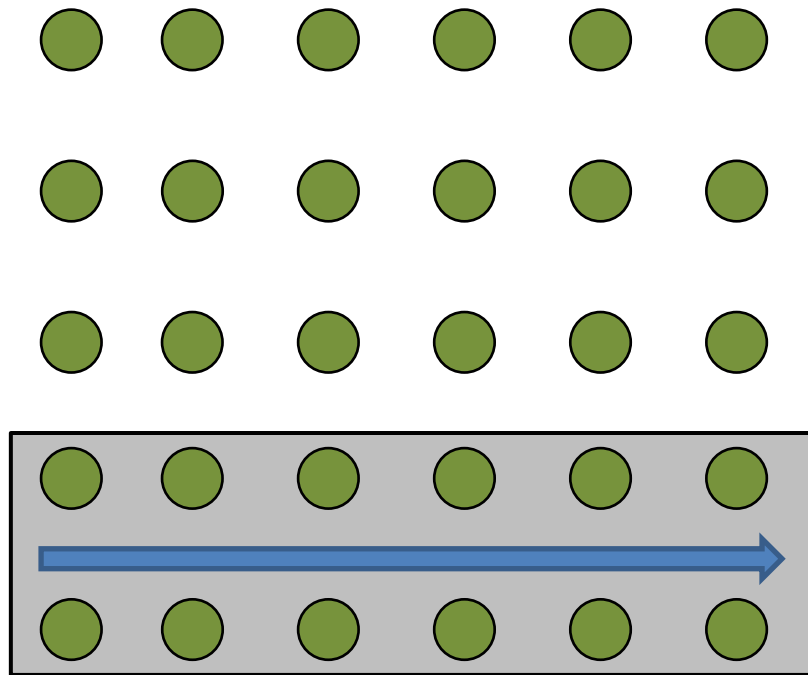
Methods

Calculations

- Fraction of days with occurrence of guttation
(e.g. 20 d with guttation out of 25 d observed -> 0.8)
- Observation of water foraging bees
standardized to 1 m² of observed crop per
minute
- Max for each study -> 90th percentile



Random square sampling



Transect walks



Example for a setup of the colonies and assessment area

Example

- Study conducted in maize in 2010 (France):
5 observation areas within the field,
4 m² each, time 4 min each
 -> 20 m² for 20 min
- 3-5 times a day (41 d), 294 observation units
- Total number of bees observed: 1
- Max: 0.0025 bees/m²/min
- Mean: 0.0000085 bees/m²/min

Results

Table 1: 90th percentile of the occurrence of guttation for the evaluated crop species and the 90th percentile of honey bees counted on 1 m² of the crop in 1 minute derived from maximum reported (worst case) values in industry studies

Crop	Season	Growth stage during which gutatton occurred (Min, Max)	90 th percentile of fraction of days with guttation	90 th percentile of bees/min/m ²	Datapoints (n)
Brassica	Spring/Summer	BBCH 13-49	1	0	1
Maize	Spring/Summer	0-53 DAE	1	0.0041	8
Onion	Spring/Summer	BBCH 13-49	0.43	0	1
Potatoes	Spring/Summer	0-57 DAE	0.61	0	2
Sugar beet	Spring	7-29 DAE BBCH 10-19	0.34	0	5
W-Barley	Autumn	BBCH 9-22	1	0.0010	2
W-Barley	Spring	BBCH 21-33	0.99	0.0079	2
S-OSR	Spring/Summer	BBCH 11-65	0.77	0	1
W-OSR	Autumn	BBCH 10-19	0.93	0.0021	4
W-OSR	Spring	BBCH 21-57	0.85	0.0051	3
W-Wheat	Autumn	NA	1	0.0005	1
W-Wheat	Spring	NA	1	0.0112	1

DAE = Days After Emergence

	Maize	Sugar beet
Guttation ¹	1	0.34
Foraging ²	0.0041	0



Guttation occurs often,
low number of foraging bees
For comparison: 3-8 bees m²/min
(Maximum numbers flowering OSR)³

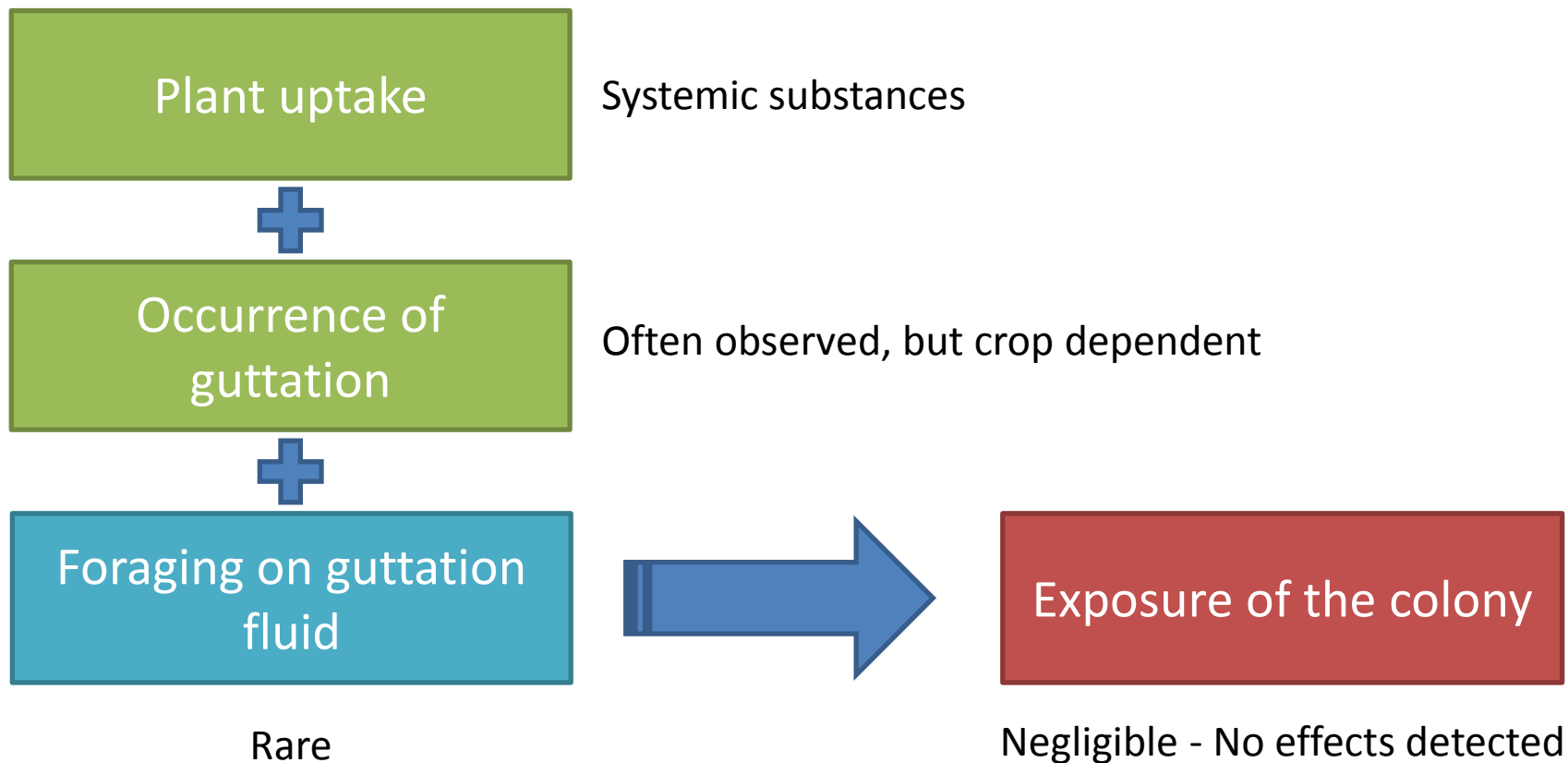


Guttation occurs seldom,
no foraging bees observed

¹ 90th percentile of fraction of days with guttation

² 90th percentile of bees/min/m²

³ Data from unpublished industry studies



Conclusions

- Occurrence of guttation frequent, but crop dependent.
- Very low numbers of water foraging honey bees.
- No effects reported on mortality and colony strength.