

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

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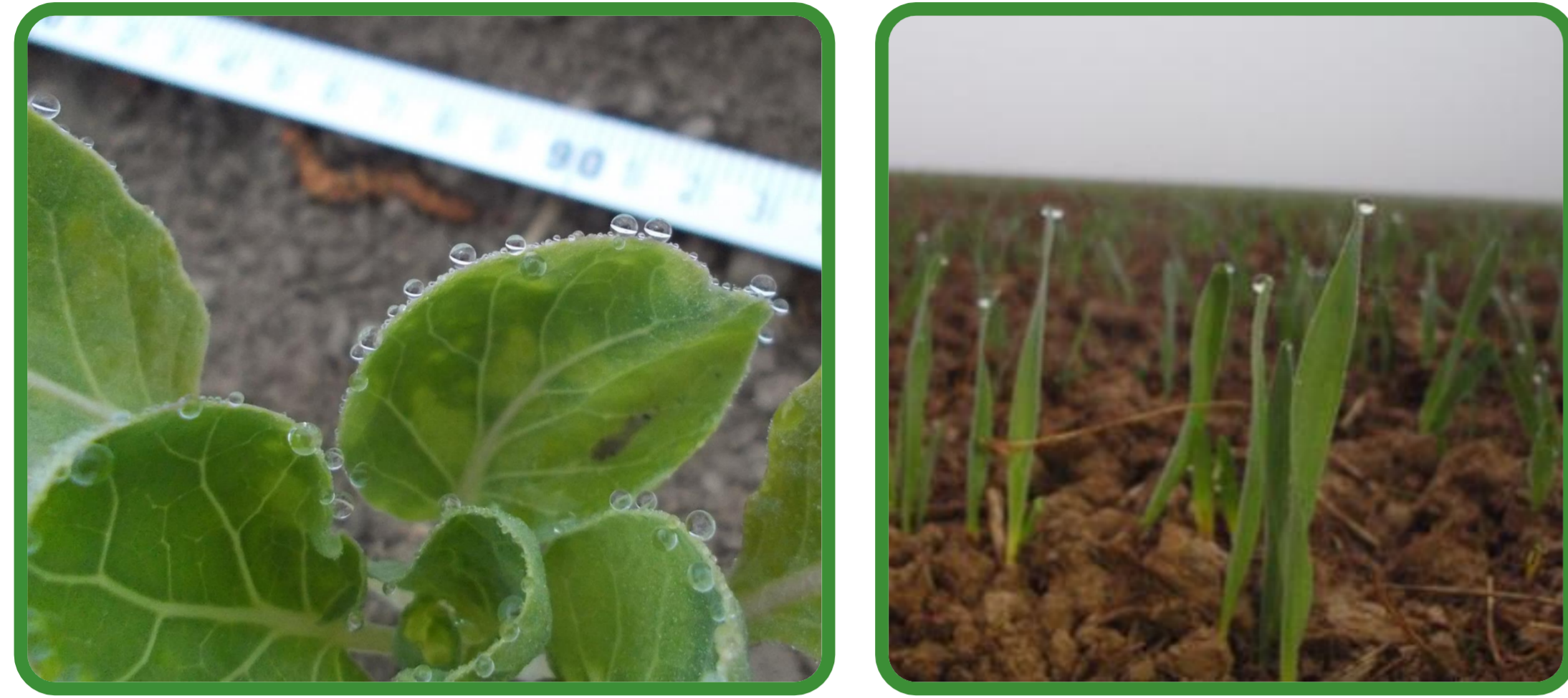


Figure 1: Guttation droplets on a cabbage plant (left) and maize (right)

INTRODUCTION

Guttation is a phenomenon in vascular plants: Under conditions of high humidity and low transpiration (e.g. during the night or in the morning) water (xylem sap) is excreted in small droplets due to root pressure.

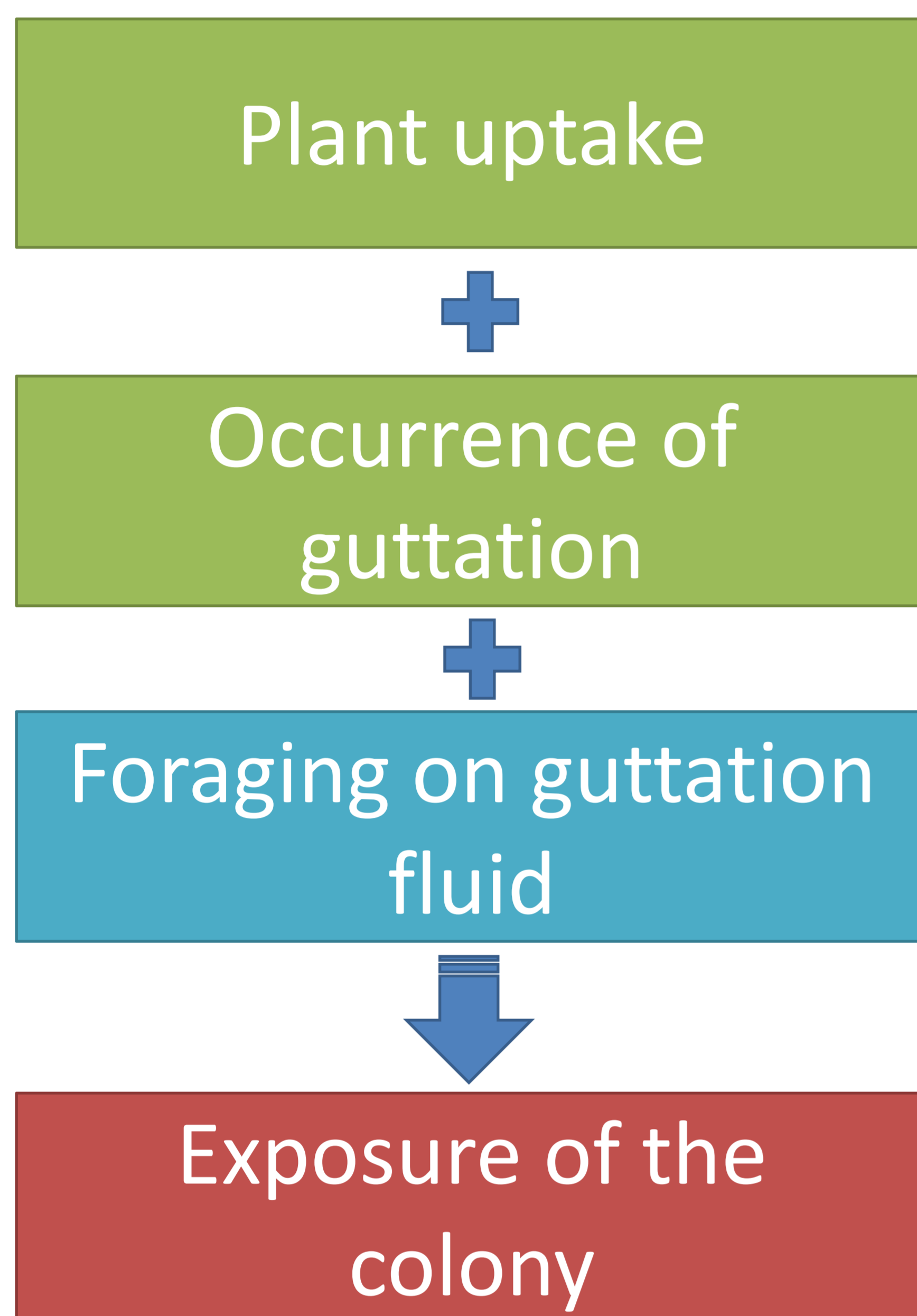
Residues of (systemic) plant protection products (PPP) can be detected at significant levels in the guttation water. Honey bees, which often serve as model species in the regulatory context, need water and are known to exploit different water sources. A potential risk exists when honey bees forage on guttation droplets to satisfy the water demand of the colony. However, the need for water of a colony is not constant (demand-driven). Water is needed for the dilution of honey (spring) or for the cooling of the hive (summer).

It is necessary to clarify how residues, occurrence of guttation and foraging behaviour together constitute the potential exposure.

METHODS

In this review we evaluated field studies investigating exposure to insecticide seed treatments *via* guttation, which were conducted by the industry for registration purposes between 2010 and 2017. The aim was to find a realistic estimate (90th percentile) for the occurrence of guttation in a certain crop species as well as an estimate for the number of honey bees foraging on guttation water (90th percentile) on a certain crop. 25 studies conducted in France, Germany and the Netherlands provided by different manufacturers of PPP were evaluated.

The days on which guttation occurred were noted as the fraction of days the crop was observed. A value of 1 (equivalent to 100%) means guttation occurred on all observation days of a study. In order to have a comparable value for the number of honey bees taking up guttation fluid the reported values were standardized to 1 square meter of observed crop for 1 minute. These data were determined for control and test item treatment, and the overall maximum (worst case) values for the fraction of days with guttation and the number of observed honey bees were recorded. In case more than one dataset per crop and season was available the 90th percentile was calculated. Additionally, as most of the studies were effect studies, findings for mortality and colony strength were summarized.



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. If a study was conducted during two different seasons (i.e. autumn and spring, with a gap for overwintering) then the findings were considered as separate datapoints

Crop	Season	Growth stage during which guttation 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	0-45 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	0.34	0	5
		BBCH 10-19			
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 Exposure

CONCLUSIONS

The available data show that neither the detection of residues in guttation droplets nor the occurrence of guttation alone are sufficient to conclude an exposure (and hence a risk) for honey bees. While frequently observed in some crops (maize), guttation may be less likely occurring in others (sugar beets). Very low numbers of water foraging honey bees on guttation droplets indicate that this a minor route of exposure. The absence of effects concerning colony strength and mortality in the industry studies with systemic insecticides can be regarded as further evidence that the interactions of the different factors (plant uptake, occurrence of guttation, foraging behaviour) do not lead to any significant exposure of honey bee colonies.