5.3 Honey bee poisoning incidents in Germany

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Introduction

In Germany, incidents with potential cause of bee poisoning are analyzed at the examination center for bee poisoning incidents (UBieV) at the JKI. As incidents – increased mortalities of foragers up to losses of colonies or even whole apiaries -may have different causes, such as exposure to bee toxic substances, e.g. pesticides, biocides and varroacides or natural causes such as mismanagement, malnutrition or diseases, cases with suspected poisoning of honey bees need detailed investigations to identify the most likely causes.

Procedure

To evaluate the potential cause of incident, bee samples, plant samples, samples of combs and other materials are sent in directly by beekeepers or by institutions involved in the investigation of incidents on site, such as plant protection services of the federal states. For the investigation of incidents it is important that appropriate bee material is available for an investigation for analysis of bee poisoning by PPP or biocides. However, for some reported incidents the amount of bee samples required for investigation were too small, too old or inappropriate for other reasons and could not therefore be analyzed.

Appropriate bee- and plant samples are initially tested for presence of bee toxic PPP or biocides using a bioassay with larvae of *Aedes aegypti* L. Wherever appropriate and sufficient material is available, samples are usually analysed for bee toxic insecticides, acaricides, nematicides, EBI fungicides which interact synergistically with some insecticides and other relevant substances using highly sensitive LC-MS/MS und GC-MS technique (140 active substances screened). If plant samples from treated crops are present, both bee and plant material are additionally analyzed for numerous non-bee toxic fungicides and herbicides, which serve as a "fingerprint" for correlation of bee and plant samples (282 active substances in all). For some samples, relevant contamination can largely be excluded due to bioassay results. In these cases, when there were clear indications that other causes than poisonings led to the incident, no chemical analysis were conducted so that resources could be more efficiently directed to other more relevant incidents.

To localise the possible floral source of reported incidents pollen from the bees' hair coat or – when present –of pollen loads, palynological analyses were conducted using a microscope and pollen origin was identified by means of size, shape, surface structure and assigned to the respective plant family, genus or even species.

Results

In 2013, 108 bee incidents with suspected poisoning by PPP or biocides were reported to the UBieV, corresponding to 1426 damaged colonies and 122 concerned beekeepers; in 2014 140, in 2015 93 incidents reported with 166 beekeepers and 1405 colonies and 100 beekeepers and 854 colonies respectively.

More detailed reports are available on the website of the examination office for bee poisoning incidents for the years 2016 and 2017 (http://bienenuntersuchung.julius-kuehn.de). For example, in 2016 144 bee incidents with suspected poisoning by PPP or biocides were reported to the UBieV, corresponding to 1353 damaged colonies and 150 concerned beekeepers. For 117 of the incidents appropriate bee material was sent in, so that an investigation for analysis of bee poisoning by PPP or biocides could be conducted. In 27 of these incidents the submitted samples were small, too old, or inappropriate for other reasons and could not therefore be analyzed. In 38 of the incidents, bee toxic insecticides were detected in bee samples. In 21 (55 %) of incidents with detection of bee toxic insecticides the active substances were insecticides deriving from bee hazardous PPP classified as B1 (i.e. any application on flowering plants including weeds or on

plants foraged by bees prohibited) and B2 (application on flowering plants only after daily bee flight until 11 p.m.), respectively, or from insecticides classified as B4 (no hazard to bees and bee colonies in approved dosage) which were incorrectly applied in combination with EBI-fungicides, in combination with other insecticides or at excessive rates. In 9 (24 %) cases, bee toxic insecticides were found which had their origin clearly from deliberate poisoning with biocides (illegal use). In 8 cases insecticides were found which derive very likely from biocides, but were also authorized as PPP in the past, so that the legality of use in agriculture could not be completely excluded.

In 2017, in total 116 bee incidents with suspected poisoning by PPP or biocides were reported to the UBieV, corresponding to 1056 damaged colonies and 129 concerned beekeepers in 15 of the incidents, bee toxic insecticides were detected in bee samples. In 12 of these incidents the active substances were insecticides deriving from bee hazardous PPP classified as B1 (any application on flowering plants including weeds or on plants foraged by bees prohibited) and B2 (application on flowering plants only after daily bee flight until 11 p.m.), respectively, or from insecticides classified as B4 (no hazard to bees and bee colonies in approved dosage) which were incorrectly applied in combination with EBI-fungicides, in combination with other insecticides or at excessive rates. In 11 cases, bee toxic insecticides were found which derive clearly from deliberate poisoning with biocides (illegal use). In 3 cases insecticides were found which derive very likely from biocides, but were also authorized as PPP in the past, so that the use agriculture could not be completely excluded.

Conclusions

For the years 2013 to 2017 the evaluation of the most frequently involved substances 2013-2017 demonstrates in table 1 that most frequent causes of bee poisoning incidents with pesticides were caused by Misuse and Abuse of products, ignorance of product label, overdosing and other avoidable causes - as products containing these bee toxic substances are labeled as hazardous for bees, with the exception of Indoxacarb for which both non—hazardous (B4) and hazardous (B1) products are available while all pyrethroids have the classification as B2 but have erroneously been applied as tankmixes with EBI-Fungicides during daily bee flight. This clearly indicates that next to risk assessment and risk management an enforcement of pesticide use conditions and obeyance of PPP labels, training of farmers and surveillance of pesticide application are most important to avoid bee poisoning incidents.

Tab.1 Residues in bee poisoning incidents

Rank	Active Substance	Other uses	2013	2014	2015	2016	2017	Sum
1	Dimethoate	-	10	13	3	4	2	32
2	Fipronil	Biocide	2	4	5	8	1	20
3	Clothianidin	Biocide	5	5	1	2	2	15
4/5	Imidacloprid	Biocide	3	5	4	0	1	13
4/5	l-Cyhalothrin + EBI-fungicide	-	4	2	3	2	2	13
6	Indoxacarb	Biocide	2	5	0	3	1	11
7	Chlorpyrifos	Biocide	3	2	1	1	1	8
8/9	a-Cypermethrin + EBI-fungicide	-	2	2	0	2	0	6
8/9	Etofenprox	Biocide	0	2	1	2	2	7
10	(zeta-) Cypermethrin	Biocide	2	2	1	2	0	7