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Annual report of the Investigation Centre for Bee Poisoning Incidents (Untersuchungsstelle für Bienenvergiftungen, UBieV) 2020

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According to § 57 (2) 11 Plant Protection Act the Julius Kühn Institute must investigate bee damages purported to result from exposure to plant protection products (PPP). In 2020, in total 147 bee incidents with suspected poisoning by PPP or biocides were reported to the UBieV, corresponding to 1284 damaged colonies and 151 concerned beekeepers. Most of the reported incidents came from Bavaria (36), followed by Baden Wurttemberg (31), North Rhine Westphalia (16), Lower Saxony (13), Mecklenburg Western Pomerania (9), Brandenburg (9), Hesse (8), Saxony (7), Schleswig Holstein (6), Rhineland Palatinate (4), Saxony Anhalt (2), Thuringia (2), Saarland (2), Hamburg (1) and Berlin (1). The degree of damage ranged from single dead bees to the total loss of colonies. In some cases entire apiaries were lost.

To evaluate the potential cause of incident, 179 bee samples, 98 plant samples, 28 samples with combs and 17 with other materials were sent in by beekeepers or involved institutions. In many cases sampling and submission of samples was carried out in cooperation with the staff of plant protection services. For 110 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. For 37 incidents the submitted samples were too small, too old or inappropriate for other reasons and could not therefore be analyzed.

In 51 % bee keepers could not provide any information about the possible cause of damage. In 33 % application of PPP in fruit, rape, cereals and other cultures and in 11 % crime was suspected.

Appropriate bee- and plant samples were initially tested for presence of unspecific bee toxic substances including PPP and biocides using a bioassay with larvae of *Aedes aegypti* L.. Based on these test results, for 85 incidents it could not be excluded, that the sample material contained residues of beetoxic PPP or biocides. Corresponding samples underwent further multi-residue chemical analyses for 200 substances, including 147 bee toxic insecticides, acaricides and nematicides as well as synergistically interacting EBI fungicides and other relevant substances using highly sensitive LC-MS/MS und GC-MS technique. If plant samples from treated crops were also present, both bee and plant material was additionally analyzed for numerous non-bee toxic fungicides and herbicides, which serve as a „fingerprint“ for correlation of bee and plant samples (293 active substances in all).

For 25 incidents, relevant contamination of bee material could largely be excluded due to bioassay results. In these cases elaborate chemical analysis could be avoided to reduce processing time so that resources could be more efficiently directed to other more relevant incidents.

In line with the routine examination on infestation with the gut parasite *Nosema apis* or *N. ceranae*, respectively, spores were found in 53 of 116 bee samples. In one bee sample high infestations was detected, suggesting that bees sent in for analyses were obtained from colonies affected with Nosemosis. In 12 bee samples infestation was medium and in the remaining samples there was only low infestation of *Nosema*.

To localise the possible floral source of reported incidents pollen from the bees' hair coat or – when present – pollen loads from 117 bee samples were analysed under the light microscope by means of size, shape, surface structure and assigned to the respective plant family, genus or even species. Results of pollen analysis can provide essential evidence of the causal floral source and therefore of the potential originator of a bee damage caused by PPP.

In line with chemical analysis in 33 of the incidents, bee toxic insecticides were detected in bee samples. The most frequent active substances causal for bee damages are presented in Table 1. In 16 of these incidents the active substances were insecticides contained in 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.). In eight of these cases bee hazardous tank mixtures were identified as possible cause and in 3 cases insecticides were found which derive very likely from biocides, but were also authorized as PPP in the past, so that illegal use in agriculture could not be completely excluded. Finally, in 6 cases, bee toxic insecticides were found which clearly derive from deliberate poisoning with biocides (crime).

Findings from biological and chemical analysis were reported to the sender of sample material. In all, 110 biological and 85 chemical reports were prepared. Additionally for all fully biologically and chemically investigated incidents, a final interpretation of the test results was provided and reported to the senders together with the chemical report. All findings and reports were also made available to the plant protection service.

The number of reported bee damages ranges slightly above last year. Regarding the number of biologically-chemically investigated incidents the proportion of potential poisoning incidents relating to plant protection products was 28 % with 24 beekeepers and 349 colonies concerned. Poisoning incidents through PPP were mainly caused by misuse of bee hazardous insecticides classified as B1 or B2, respectively or bee hazard-

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Tab. 1. Most frequent active substances causal for bee damages in 2020.

active substances	classification as plant protection product	other uses	number of damages
thiacloprid + EBI*	B1 in combination (alone B4)	–	8
etofenprox	B2	biocide	6
dimethoate	B1	–	4
pyrethrine	B1, B3, B4**	biocide	4
indoxacarb	B1	biocide	3
permethrin	not approved	biocide	2
acetamiprid + thiacloprid	B1 in combination (alone B4)	–	1
chlorpyrifos	not approved	biocide	1
clothianidin	not approved	biocide	1
beta-cyfluthrin	B2	–	1

* fungicides from the group of ergosterol-biosynthesis inhibitors (so-called azol-fungicides)
** different classification corresponding to the approved dose rate and the field of use of the respective PPP

ous tank mixes of insecticides with specific fungicides. Nearly all of these incidents could be connected to disregard of the German Bee Protection Act. In 3.5 % of the investigated incidents bee toxic active substances from biocides or PPP, which are not approved any more, were involved. However, these substances were often detected in traces only and could not be linked to any special source. 7 % of the investigated incidents could be attributed to crime since detected active substances clearly derive from biocides and were predominantly detected in high doses. The most frequently detected bee toxic active substance was the insecticide thiacloprid in combination with so-called azol fungicides. Due to new findings synergistic properties of thiacloprid, which is included in PPP labelled as not hazardous to bees, in combination with single active substances from the group of azol fungicides could not be excluded so that for safety reasons all combinations had to be classified as hazardous to bees. However, no effective damage of concerned bee colonies could be proved since concentrations in bees ranged at the limit of detection far below any bee hazardous concentrations.

In all 33 nationwide poisoning incidents for which poisoning through PPP or biocides was likely or at least could not be excluded a total of 35 beekeepers and 465 colonies were involved. In more than a half (61 %) of the investigated incidents no bee toxic active substances from PPP or biocides could be detected in bees using highly sensitive LC/MS/MS and GC/MS for residue analysis.

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