Acute treatment with flupyradifurone reduced sensory responses and cognitive performance as well as motor behavior with typical indications of toxification such as walking in circles of falling on the back.

Generally, low concentrations of flupyradifurone had smaller effects on behavior than the hitherto frequently used neonicotinoids. However, we also see a negative impact of this novel insecticide on honeybees, even though it may sometimes only become apparent under stressed situations.

1.9 Dust drift from treated seeds during seed drilling: comparison of residue deposition in soil and plants

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Abstract

Drilling of seeds treated with plant protection products leads to dust drift carrying active substances (a.s.) into adjacent areas. Since these residues potentially pose a risk for bees, standardised field experiments have been conducted between 2009 and 2017 to investigate the deposition pattern of a.s. and the potential bee exposure to a.s. The large resulting data set contains a lot of information that can be used to improve our understanding of how different parameters influence the deposition pattern of dust and a.s. of seed treatments. For the present analysis, residues sampled in different matrices were used, including Petri dishes placed on bare soil and within neighbouring cultures (oil seed rape and mustard) as well as plant material (divided into flowering and non-flowering plant parts). In a nested design, multiple samples were taken at each distance of 0, 1, 3 and 5 m from the field edge within a total of 6 blocks per trial. The a.s. content per sample was determined analytically, using high-performance liquid chromatography coupled to tandem mass spectrometry (HPLC-MS/MS).

By means of generalized linear mixed effect models (GLMM; R package 'lme4') and automated model selection (R package 'MuMIn'), the effects of environmental and drilling parameters, seed treatment quality and sampling matrix were analysed taking into account the information from multiple trials and thus allowing for analysing the effects independently from another. A high amount of variation cannot be explained by the resulting models, probably due to environmental factors not incorporated into the models, such as varying wind speed and direction as well was heterogeneous field characteristics (terrain, crop density). However, the incorporated fixed effects resulted to be relevant in the majority of the selected models. Overall, the dust-borne a.s. emission per hectar (Heubach value expressed as g a.s./ha) has a strong impact on the amount of residues, which decrease markedly within the observed distance of 5 m to the field edge. Comparing different sampling matrices, *i.e.*, flowering plant parts and ground-based Petri dishes, a similar distance-related residue pattern was observed within the neighbouring crops. Based on field realistic data, the presented results will contribute to enabling a more precise risk assessment of seed treatment applications with regard to bees.

1.10 Coumaphos residues in beeswax after a single application of CheckMite® affect larval development *in vitro*

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Abstract

Coumaphos is an organophosphate insecticide used on bees for the control of the parasitic mite *Varroa destructor*. We studied the distribution of coumaphos in beeswax after a single application of CheckMite® and

studied the effect of coumaphos in beeswax on larval development. Fifteen *Apis mellifera* colonies were treated with CheckMite® containing 2.72 g of coumaphos per application. During the following spring season, average coumaphos levels of 65 mg/kg were measured in combs that came into contact with the strips and average concentrations of 6.7 mg/kg were measured in combs that did not come into contact with the strips. Coumaphos was also detected in wax that was not present during the treatment, such as newly constructed wax, wax of honeycombs and capping wax, respectively. *In vitro* larval rearing in cups coated with beeswax containing coumaphos at a concentration of 70 mg/kg or 10 mg/kg demonstrated that coumaphos levels of 70 mg/kg in beeswax negatively affected larval development, while no differences to the controls (0 mg/kg) were observed for larvae exposed to beeswax containing coumaphos at 10 mg/kg. Therefore, beeswax exposed to CheckMite® should not be recycled in order to prevent elevated coumaphos residues in new foundations and hence to prevent honeybee larvae from being exposed to high residue levels. For further information please see Kast, C., Kilchenmann, V. and Droz, B. (2019) Distribution of coumaphos in beeswax after treatment of honeybee colonies with CheckMite® against the parasitical mite *Varroa destructor.* Apidologie

1.11 Exposure following pre-flowering insecticide applications to pollinators

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Abstract

Applying insecticides pre-flowering can mitigate the risk to pollinators by significantly reducing exposure via both contact and dietary routes. Methods have been developed to quantify the exposure of foraging honeybees, bumblebees and solitary bees to insecticides following pre-flowering applications. The insecticide sulfoxaflor was applied pre-flowering at BBCH 55 to a variety of target crops at five different sites across Europe. The subsequent residue levels on foliage after application were determined to investigate the decline of residues prior to flowering. When the crop reached the flowering stage at BBCH 60, residue levels in pollen and nectar were determined to provide an estimate of potential maximum exposure to pollinators and rate of decline in pollen and nectar. Exposure levels were compared to results from effect studies with honeybees, bumblebees and solitary bees. With honey bees, effect assessments included mortality, foraging activity, behaviour and colony condition assessments. Nectar and pollen were sampled from forager bees, pollen traps, and from combs to determine levels of dietary exposure. Effects on bumblebees were investigated by mortality assessments in the colony and tunnel, together with assessments of foraging activity, colony weight, queen production and brood assessments at the start and end of the study. Dietary exposure to bumblebees was determined by analysis of nectar and pollen collected from forager bees and in nectar and pollen pots in the colony. Effects on solitary bees (*Osmia bicornis)* were assessed following applications to oilseed rape in tunnels. Assessments included hatching rate, nest occupation, flight activity, cell and cocoon production and hatching success. Dietary exposure was determined in nectar and pollen collected from plants. Results from both exposure and effect studies will be presented together with a discussion on risk to pollinators and mitigation with pre-flowering applications.

1.12 Assessing effects of insecticide seed treatments on pollinators in oilseed rape and maize

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Abstract

To fully assess the risk of insecticide seed treatments in oilseed rape and maize, methods have been development to investigate effects of seeds treated with cyantraniliprole on pollinators. Tunnel studies were conducted with oilseed rape grown from treated seed combining exposure and effects assessment on honey