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Sprayed and seed dressed pesticides in pollen, nectar and honey of oilseed rape

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Introduction

Oilseed rape is almost exclusively produced as an intense cultivation. Seeds are treated before sowing with systemic insecticides, nowadays primarily with neonicotinoids. In the blooming period, sprays against fungi (*Sclerotinia sclero)* or pests (e.g. *Ceutorhynchus assimilis*) with different non hazardous pesticides are common. These substances are known to reach pollen and nectar. Contaminants in food sources are actually discussed as sublethal factors influencing colony health. Residues are adverse for the image of honey.

Experimental

In a study to quantitative study the presence of residues in nectar, pollen and honey conditions, two fungicides were sprayed into an 8 ha blooming cultivation in accordance with normal agricultural practice in Germany. Over a 7 day period, residues of the seed dressed insecticide and the sprayed fungicides were measured in the pollen and nectar loads of returning foragers. Unripe honey from combs and extracted honeys were analyzed.

16th April 2007: Application of the fungicides Cantus® (boscalid, 500g a.i./kg), 0,5 kg/ha) and Proline® (prothioconazol, 250g a.i./kg, 0,7 kg/ha) in an 8 ha oilseed rape field (variety *Smart)*, seed dressed with the insecticide Elado Premiumbeize® (clothianidin a.o.). Both fungicides act systemically and can be combined with non hazardous pyrethroids or neonicotinoids insecticides. The fungicides were sprayed in combined application with 250 l water per ha.

Two apiaries (2 respectivally 7 colonies) at 200 m distance to the sprayed oilseed rape field were used for the experiments.

Returning foragers were caught at the hive entrance with a special vacuum cleaner. The bees were immediately shock frozen with carbon dioxide snow and stored at -20°C until preparation. Thus, starting from the day before application, at least three series with around 100-150 bees were collected per day over a 7 day period

In the lab, the pollen loads and the collected nectar of the honey sacs were prepared separately for each trapped group of forager bees. The pollen loads were sorted by color and the origin was checked under the microscope. Only oilseed rape pollen was used for further analysis. In total 22 pooled pollen and 22 pooled nectar samples were prepared with an adapted QuEChERS-multi method and analyzed with tandem LC-MS/MS. The quantitation limits for the different substances in the analysis were as follows:

- Boscalid in pollen, nectar and honey: 0,001 mg/kg
- Prothioconazol in nectar und honey: 0,001 mg/kg
- Prothioconazol in pollen: 0,010 mg/kg
- Clothianidin in pollen, nectar und honey: 0,001 mg/kg

Results

Pesticides in pollen loads

Prothioconazol and clothianidin were not detected in the pollen loads of returning bees over the whole period.

Boscalid was detected in all 22 series. At the day of application the detected average boscalid value in the pollen loads was 13.9 mg/kg and at the following day 26.2 mg/kg. At the second day the contamination decreased to 4.7 mg/kg and stayed on this level the following days. At 7 days after the application, boscalid was still measured at levels around 3 mg/kg.

Residues in nectar

All three pesticides were detected in the nectar in the honey sac loads over the 7 day period. Boscalid and prothioconazol residues were in high ppb-levels after the application (1.43 mg/kg respectivally 0.69 mg/kg). The values decreased to 0.13 respectively 0.06 mg/kg the following day and for both substances to 0.017 mg/kg the second day. After 7 days the boscalid value reached 0.025 mg/kg and the prothioconazol 0.009 mg/kg. The clothianidin values moved between 0.001-0.003 mg/kg and were always near the limit of quantitation. Clothianidin acted like an internal standard and showed that the forager bees intensely used the treated oilseed rape field.

Conclusions

Spraying of boscalid in oil seed rape according to normal agricultural practice in Germany causes residues in pollen (above the German MRL), nectar and honey. Prothioconazol was detected in nectar and honey. Due to matrix effects and irreversible adsorption effects, this pesticide is not detectable in pollen. Its residual behavior is still unclear. Clothianidin migrates from the plant into nectar in low traces near the LoQ. Even with low quantitation limits (0.001 mg/kg), this insecticide was not detected in pollen or honey. The fungicide spray application leads to appreciably higher residues in the bee products than the seed treatment, particularly in the time after the application. Systemic properties of the three substances induce the contamination of pollen and nectar over a prolonged time. The hydrophilic character of the fungicides may lead to relatively low residues in rape oil, but to relative high residues in honey. Pollen traps should be closed at least for the first few days after spray applications.

Colony losses – interactions of plant protection products and other factors

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Abstract

In recent years repeated colony losses occurred in Germany. Besides Varroosis many other possible causes like bee diseases, nutrition supply as well as effects of pesticides have been discussed.

A chronic feeding study was conducted to find indications to what extent negative effects of pesticides in sub-lethal doses can be discerned from effects of other stressors (pathogens, drugs, mix of plant protection products, malnutrition of proteins) or any interactions or coactions.

In a screening programme effects of chronic dietary exposure to sub-lethal doses of the insecticide imidacloprid were studied in honeybees under stress of another potential stressor (*Varroa destructor*, *Nosema apis*, drugs, lack of pollen supply). The results confirm a chronic oral toxicity of imidacloprid at concentrations which in several previous studies have been reported to be toxic to bees (100 ppb). However, no indications were found for significant differences in sensitivity to imidacloprid between bees under other stressors and control bees.