

Linking of exposure and effects in higher tiers of the assessment of the risk of pesticides to honeybees as proposed in the EFSA guidance document

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1. Introduction

Any assessment of the risk of pesticides to organisms has to include both the assessment of the exposure of the organisms and the effect on these organisms [1]. In line with this, the draft EFSA guidance document for the risk assessment of bees [2] described a risk assessment procedure that is based on two goals: an effect assessment goal and an exposure assessment goal. It is crucial that the exposure assessment and the effect assessment are adequately linked, especially in the higher tiers of the effect assessment because these tiers decide on the acceptability of the risk for all critical compounds. So the problem is how this linking should be done for e.g. higher-tier field effect studies with honeybees.

2. Materials and methods

In the past decade the procedures for linking of exposure and effect assessments have been developed well for the aquatic effect assessment [3,4,5]. The procedure is to develop in parallel both an effect and an exposure assessment scheme and to link these by selecting the most relevant type of concentration, i.e. the Ecotoxicological Relevant type of Concentration (ERC). We propose to follow the same principles for the bee risk assessment. EFSA [2] proposed to base the effect assessment primarily on the concentration in nectar and pollen entering the hive and to combine these concentrations with consumption rates of nectar and pollen by adult bees and larvae (in the assessment of these consumption rates the sugar concentration in the nectar plays an important role; see Appendix S of EFSA [2] for details). Later also contributions of guttation water and other water sources may be considered [2]. Furthermore it is proposed to base the field-exposure assessment on a 90th percentile of the exposure concentration considering a well-defined statistical population of hives, i.e. all hives at edges of treated fields in the area of use of the substance. This 90th percentile is based for each hive on the maximum in time following the pesticide application.

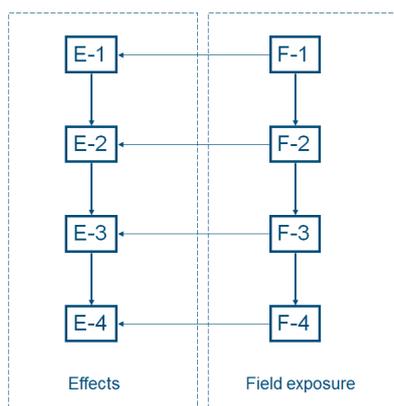


Figure 1: Combined tiered effect and exposure schemes for solving a risk assessment problem. The boxes E-1 to E-4 are four effect tiers and the boxes F-1 to F-4 are four tiers for assessment of exposure in the field ('F' from 'field'). Downward arrows indicate movement to a higher tier. Horizontal arrows from the exposure to the effect scheme indicate delivery of field exposure estimates for comparison with effect concentrations in the effect scheme (after Boesten et al. [3]).

There are two types of exposure assessment in such a linked risk assessment procedure: (A) the exposure of the hive in the field resulting from the use of the pesticide in agriculture (resulting in the 90th percentile concentration described above), and (B) the exposure of the hive in the higher-tier effect studies. In the past, the concentrations in nectar and pollen in the hives in the regulatory studies was usually not measured; instead it was assumed that exposure was adequate e.g. because the hive was located at the edge of a treated oilseed rape field. However, it is questionable whether this is a defensible approach to achieve at least a 90th percentile exposure because there are no data available that relate concentrations in nectar and

pollen in a treated field to the average concentrations entering the hive. Therefore we recommend to measure in higher-tier semi-field and field studies always the course of time of the concentrations in nectar and pollen entering the hive. For adequate linking it is needed that the exposure in the higher-tier studies is equal or higher than the endpoint of the field-exposure assessment (90th percentile exposure). Otherwise the outcome of such a higher-tier effect study may be that there are no unacceptable effects at a concentration that is lower than the endpoint of the exposure assessment which is a non-relevant result for the risk assessment.

3. Results and discussion

Let us consider an example of a parallel tiered effect and exposure assessment to illustrate the above procedure. We limit ourselves in this example to the risk resulting from nectar consumption from adjacent crops after a spray application of 1 kg/ha (see Figure 5 of EFSA [2]). The default RUD (21 mg/kg) and the default conservative spray drift (7%), both taken from EFSA [2], give a nectar concentration in the first tier of 1.5 mg/kg (box F-1 in Figure 1). Let us assume a drift reducing measure in a second tier that gives 50% spray drift reduction, so nectar concentration of 0.7 mg/kg (box F-2). Figure 5 of EFSA [2] gives as one of the higher tier options assessment of 90th percentiles based on probabilistic modelling of spray drift using the default RUD. Let us assume that this gives a 90th percentile nectar concentration of 0.3 mg/kg as a third tier (box F-3). Let us assume that this 0.3 mg/kg results in unacceptable risks when compared to the first-tier ETR_{adult} trigger (so box E-1 gives unacceptable risk). Let us assume further that now as the next effect tier (box E-2) a field study on effects on bees is available which showed no effects after spraying the substance onto a flowering oilseed rape field at a rate of 1 kg/ha next to the hive. Let us further assume that the actual RUD in this field study was 2 mg/kg, so the nectar concentration in the flowers was 2 mg/kg. The point is now whether the maximum in time of the measured nectar concentration entering the hive (average of all entering foragers) was above or below 0.3 mg/kg. If it was above 0.3 mg/kg then the conclusion is that the risk is acceptable for this aspect. If it was below 0.3 mg/kg, we do not know whether the risk is acceptable. It may have been e.g. about 0.1 mg/kg because the foraging area happened to contain also 20 ha untreated flowering oilseed rape which diluted the concentration entering the hive. However, it may have been close to 2 mg/kg if there were no competing other nectar sources in the foraging area. Measurement of this concentration is therefore crucial for an appropriate linking of exposure and effects in the risk assessment.

4. Conclusion

In higher-tier field studies on the effects of pesticides on honeybees (considering the exposure via consumption of nectar and pollen) the concentration in nectar and pollen entering the hive should be measured as a function of time. In analogy, it is also advisable to measure the sugar concentration in this nectar as a function of time in view of its important role in the assessment of the daily consumption rates of the nectar.

5. References

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