5.2 BEEHAVE validation and resulting insights for the design of field studies with bees

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Abstract

Factors affecting honey bee health are manifold (including diseases, parasites, pesticides, environment and socioeconomic factors). A lack of standard procedures for higher tier risk assessment of plant protection products for bees makes coherent availability of data, their interpretation, and their use for higher tier risk assessment challenging. Focus has therefore been given to the development of modelling approaches which in the future could fill this gap. BEEHAVE is the first model attempting to link two of the processes vital for the assessment of bee mortality; the within-hive dynamics for honey bee colonies and bee foraging in heterogeneous and dynamic landscapes.

Here we show results of several BEEHAVE validation studies conducted. We specifically focus on insights gathered through these modelling exercises for the design and the usability of field studies for further development, testing and validation of the BEEHAVE model.

Overall the model validation shows that predictions of bee hive dynamics fit observations of the total number of adult bees, the total number of offspring in the hive, and the production of drones well. This result underpins the results of the EFSA evaluation of the BEEHAVE model, that the most important inhive dynamics are represented and correctly implemented in the model, with empirical evidence. Agreement between data and model predictions is particularly high for the initial experimental phase prior the generally conducted relocation of the bee hive from the actual experimental landscape to an overwintering site. Increased discrepancy following the relocation is an artefact of lack of information on the landscape characterisation of the overwintering site for model parameterisation; leading to increased inaccuracy of the model prediction for pollen and nectar resources in the hive, that in turn determines the abundance of bees and thus the overwintering survival probability of the colony.

It is vital to redistribute experimental efforts allocated to a field study to better assess the suitability of using BEEHAVE for the prediction of bee colony overwintering survival as an important endpoint for higher-tier risk assessment for bees. A more equal bee hive and landscape investigation throughout the entire field study, rather than a bias towards the actual exposure phase, is required to improve data availability for model validation.

5.3 Bee pollinator toxicogenomics: an interdisciplinary approach to unravel molecular determinants of insecticide selectivity

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Abstract

A favorable bee profile is one of the key requirements in the development and (re)registration of insecticides. While the toxicity of insecticides to bees is routinely assessed according to officially published guidelines and guidance documents, their interactions with bees on the molecular and biochemical level have not been intensively studied, yet.

Thus, Bayer AG, Crop Science Division, initiated the project “Bee Pollinator Toxicogenomics” with the particular aim to elucidate the molecular basis of selectivity of insecticides against bee pollinators with special reference to a comparative functional genomics approach covering different bee species in cooperation with external partners.