bees, bumblebees and solitary bees in Germany and Italy. 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 exposure. Effects on bumblebees were investigated by mortality assessments in the colony and tunnel, foraging activity, colony weight, queen production and brood assessments at the start and end of the study. 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 were assessed with oilseed rape treated seed in tunnels with *Osmia bicornis*. Assessments included hatching rate, nest occupation, flight activity, cell and cocoon production and hatching success. Exposure was determined in nectar and pollen collected from plants. Honeybee field studies with cyantraniliprole treated maize seed were conducted in Germany and Italy. Colonies were placed in the fields prior to the onset of the guttation period at BBCH 10. Mortality, foraging activity on guttation fluid and colony condition assessments were made throughout the guttation period, together with residue analysis of the guttation fluid. Colonies were then exposed to maize pollen during flowering and similar assessments conducted plus residue analysis of pollen collected from pollen traps and combs. The abundance and species richness of naturally occurring wild bees in treated and untreated field plots of maize and adjacent field margins during pollen shedding were also investigated to gain further understanding of exposure and effects on wild pollinators in maize. To evaluate a wide range of wild bee species occurring at field sites during pollen shedding period, two methods were used: a non-selective method and a selective method. For the non-selective method two different types of traps were used. Vane traps and bee bowls were installed at three sampling areas: in the centre of the maize fields, at the borders of the fields (inside the maize crop) and outside at in the adjacent field margin. The selective sweep netting method was used in the crop centre and at the border of the fields (inside the maize crop) via transect walks in a defined distance and time interval. Additionally, nesting units were provided for solitary wild bee species that breed in woody cavities. The trap nests were set up at the centre and adjacent field margin and used for sampling of pollen to assess how attractive the maize pollen is to the cavity breeding species compared to other available pollen sources at the time of the year by pollen identification of pollen mass samples. In addition, residue analysis was performed with samples of pollen mass. Results from all the studies will be presented together with the risk of cyantraniliprole treated oilseed rape and maize seed to honeybees and wild pollinators.

1.13 Conservation and creation of multi-functional margins to maintain and increase the pollinator biodiversity in agricultural environments (d)

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Abstract

When a natural ecosystem changes its use in agriculture, factors that greatly affect its fauna, especially insects, are introduced. This kind of land change, and especially intensive production models causes a clear loss of biodiversity, with a drastic decrease in the number of plant species that in turn affects the natural pollinator entomofauna.

In 2010, one of the main conclusions reached by the European Commission for the Conservation of the Environment was the need to promote research on the conservation, restoration and sustainable use of the diversity of pollinators in agriculture. This situation together with the climate change and the notable decrease in the number of wild pollinators has meant that the European Union, FAO (United Nations Food Organization) and other important international organizations have raised the alarm about the need to look for how to maintain and increase the presence of wild pollinators.

In order to find practical solutions, the company Syngenta Crop Protection launched the "Operation Pollinator (OP)" project in 2009, a European-level initiative launched in Britain as part of the EU action called EPI ("European Initiative on Pollinators"), whose main objective is to protect pollinators, increase their biodiversity and promote their presence and also other beneficial or auxiliary arthropods in the crops.

The present study collects the results obtained in different agricultural farms of the Iberian Peninsula, demonstrating how right agricultural practices can also help to maintain biodiversity and favour its rapid increase, both qualitatively and quantitatively.

1.14 Applied statistics in field and semi-field studies with bees

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Abstract

Field and semi-field studies are important tools in the ecotoxicological risk assessment of plant protection products for bees (honey bees, bumblebees and solitary bees). While these studies represent far more realistic conditions than laboratory tests, they also present a challenge for the analysis and interpretation due to the large and complex datasets. Therefore, in order to correctly answer the underlying ecotoxicological questions, it is crucial that these studies are not only thoroughly planned and conducted, it is also important that they are subjected to adequate statistical analysis. Our aim is to provide a better understanding on how to conduct and interpret statistical analyses in field and semi-field studies with bees made for regulatory purposes. An overview of how study design and statistics should be aligned with each other is given including the specific challenges of (semi-) field trials, as for instance how to address the problem of pseudoreplication if hives are regarded as experimental units. Different statistical tools are compared and their suitability for different data types and questions are discussed. Generalized Linear (Mixed) Models (GLMMs) are evaluated in more detail as they provide a flexible and robust tool for the analysis of honey bee (semi-) field data. Furthermore, some more light is shed on what p-values really tell us, how they can help to interpret data and how they should not be misinterpreted.

Keywords: Applied statistic, bees, field studies, plant protection products

Introduction

Field and semi-field studies are important tools in the ecotoxicological risk assessment of plant protection products for bees (honey bees, bumblebees and solitary bees). While these studies represent far more realistic conditions than laboratory tests, they also are a challenge for the analysis and interpretation due to the large and complex datasets. Therefore, in order to answer the underlying ecotoxicological questions correctly, it is crucial that these studies are not only thoroughly planned and conducted but also subjected to adequate statistical analyses. The choice of method for the analysis depends on the experimental setup, the consequential data set, and the possible effects. The steps that should be followed to obtain a satisfying and meaningful result and the challenges that have to be considered on the way are explained in the following.

Data exploration

Data exploration is a crucial step in analyzing the data that should preceed any further analysis. It intends to familiarize oneself with the data and getting to know its limitations. Data exploration includes the investigation of outliers, homogeneity, normality, zero observations, correlation between covariates (collinearity), nonlinear relationships among variables, temporal and spatial dependency (Zuur *et al*. 2010, Zuur *et al*. 2016).

Statistical methods

A key advice in statistics is to 'keep it simple', indicating that the simplest statistical test should be applied to the data but only if it is applied correctly. Often 'real world' data violate the assumptions of simple tests like ANOVA or linear regression (*i.e*., normality, homogeneity, independence of data).

Depending on the typology of the response variable and limitations detected during data exploration the adequate model is fitted: (G)LMM, beta regression model, Zero-inflated model or GAMM to name only the most common.