WHY ARE MAMMALIAN FOCAL SPECIES UNAFFECTED BY CHLORPYRIFOS APPLICATIONS? INTEGRATING DATA ON FORAGING-BEHAVIOUR, EXPOSURE, AND TOXICOKINETICS

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Introduction

For chlorpyrifos (CP), the Tier 1 risk assessment for **small mammals** indicates a high risk. This is based on laboratory toxicity studies and generic worst-case dietary exposure estimates. However, to achieve a *realistic* risk assessment, it is important to understand the foraging-behaviour of a focal-species in relation to a crop and its growth-stage. Cropped fields are generally not primary habitats for small mammals. Carrying-capacity of primary habitats may be exceeded (e.g. common vole in grassland) leading to 'overspill' into crops. Scarcity of primary habitat (e.g. hedgerows for woodmice) can also lead to foraging in-crop. Natural breeding-cycles and population-growth also need to be accounted for. For CP, field studies have been conducted to incorporate these factors in a realistic risk assessment. Quantified residues in food items, dissipation-rate, foraging-behaviour and toxico-kinetics have also been combined in Body-Burden Modelling. The latter provided an explanation for the empirical field results, to complete a holistic risk assessment.

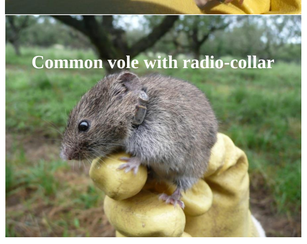
Materials and Methods

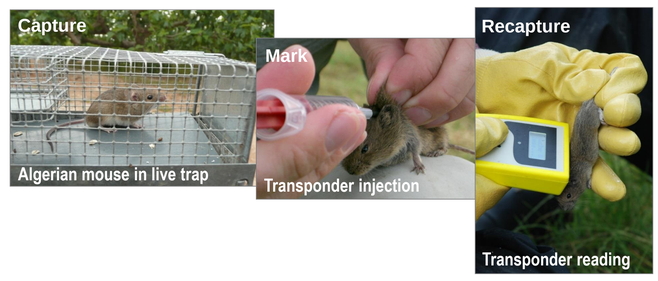
To gain information on individuals, populations and communities within CP-treated fields a program of field studies was undertaken.

4 crops (apples, citrus, brassicas, grassland)
5 countries (UK, Spain ES, Czech CZ, Poland PO, Germany DE)
6 large scale field studies (2007-2014)

The objectives and methods used were to obtain information on:

- ✓ Diversity and abundance by thermoimaging & live-trapping
- ✓ Habitat-selection, home-range, & time foraging in-crop by radio-tracking
- ✓ Composition of diets by analysing stomach contents
- ✓ Residues of CP in food items (arthropods, ground-vegetation) and DT_{50}
- ✓ Impact of CP-application on individuals and populations by radio-tracking, carcass-searches and live-trapping (Capture-Mark-Recapture CMR)
- ✓ Potential long-term impact of CP on populations by live-trapping (CMR) to assess population-size & -growth, age-structure, sex ratio & reproduction
- ✓ WHY the empirical results showed no effects, by accounting for Toxicokinetics (TK) and Toxicodynamics (TD) through the use of body burden modelling (BBM) [*also please see poster TU159 for details*]

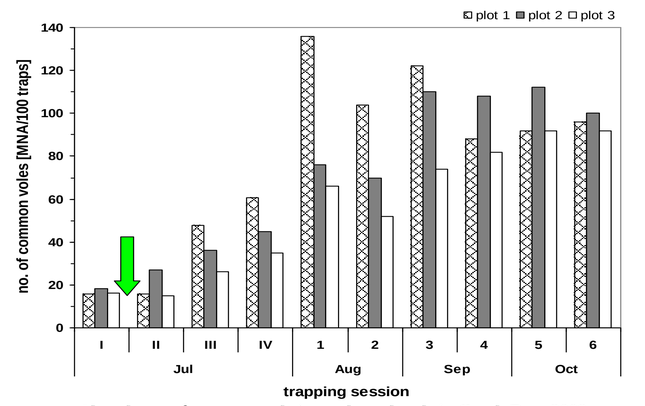




Orange showing damage by target pest for CP, California red scale

Apple showing damage by a target pest for CP, codling moth

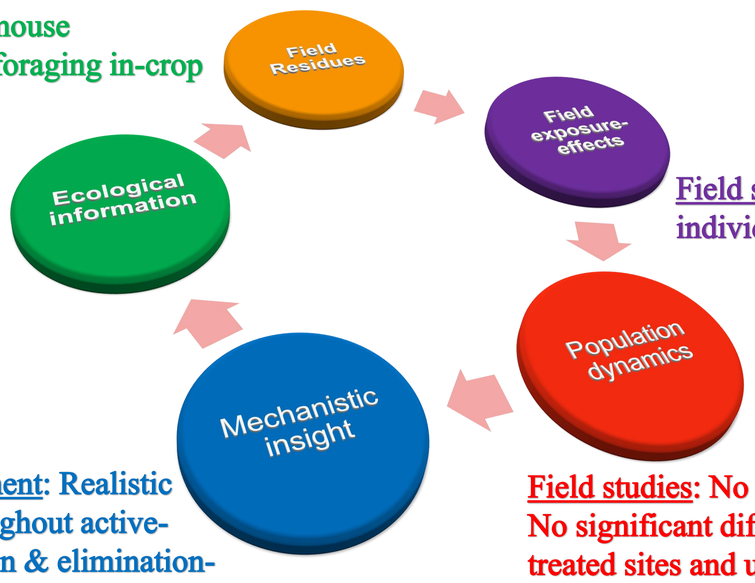
Results

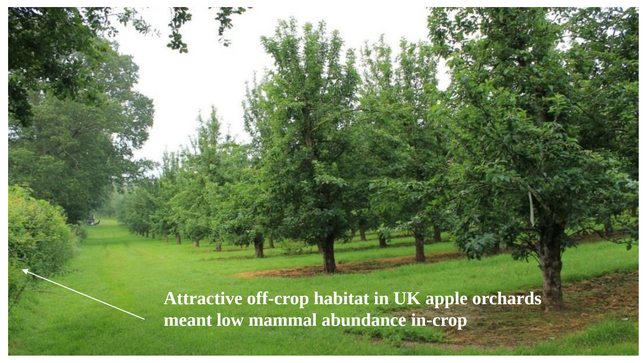


Abundance of common vole in apple orchards in Czech Rep. 2009
Arrow denotes application timing, at 0.96 kg a.i./ha

Citrus ES: Mainly Algerian mice, & few wood mice
Populations only present if weedy ground-cover
No herbivorous mammals.
Apples: CZ: common vole & wood mouse
UK: Attractive off-crop = very little foraging in-crop
Brassicas PO: Mainly brown hare,
& few common vole

Measured DT_{50} on food items (vegetation & arthropods) is short approx. 2-3 days



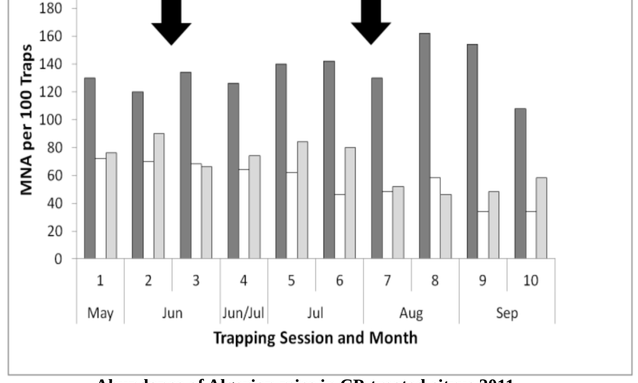


High abundance of Algerian mouse at site 2 was due to the large extent of weedy ground cover in this citrus grove, which is proliferated by drip irrigation

Field studies: No CP-related effects on individuals nor populations.

Body Burden Modelling risk assessment: Realistic residues on food items, feeding throughout active-period, and realistic dietary absorption & elimination-rate. Conclusion of BBM was no focal species was able to feed fast enough to reach toxicologically-relevant body burden. i.e. no effect was predicted.
[*Please see poster TU159 for details*]

Field studies: No effects on bodyweight.
No significant difference in reproductive activity between treated sites and untreated reference sites
No difference in proportion of juveniles between treated and untreated reference sites
No short or long-term effect on population-growth nor abundance



Abundance of Algerian mice in CP-treated citrus 2011
(arrows denote application timing at 2.4 kg a.i./ha)

Conclusions: Why are mammalian focal species unaffected by chlorpyrifos applications?

i.In general, the in-crop area (i.e. the CP-treated area in this case) is not a primary habitat for small mammals. Vegetation-cover (from predators) and food sources in adjacent permanent off-crop habitats (e.g. hedgerows, woodland, grassland) tends to make these areas preferable for small mammals.

ii.Potential 'exposure-window' is short due to relatively fast dissipation of residues on food items (arthropods and vegetation)

iii.Potential dietary exposure in the field is gradual during whole active foraging period (i.e. not all-at-once as in gavage-dose laboratory studies)

iv.In combination with iii, rapid metabolism & elimination of CP within the mammal, result in the body burden not exceeding toxic levels.

This holistic approach which integrates multiple field studies and Body Burden Modeling is a believed to be unique in providing a more realistic and robust assessment of the acute, short-term and long-term risk to wild mammals from the use of a pesticide.

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Acknowledgments
We thank ADAMA Agricultural Solutions Ltd. for co-funding these studies