Cambridge Environmental Assessments

An alternative method for the estimation of arthropod exposure to pesticides

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Outline

- **Project introduction**
- **Current exposure estimates**
  - In-field
  - Off-field
- **Alternative exposure approach**
- **Research recommendations, end use**
- **Effects**

Context of this work

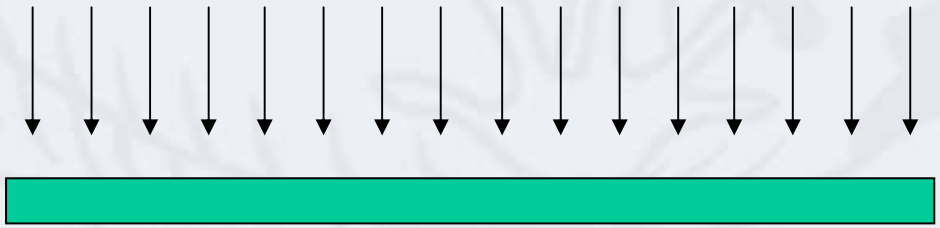
- **UK PSD funded project WEBFRAM**
  - Aim to increase realism in risk assessment for non-target organisms
  - Deterministic and probabilistic techniques
  - Modules cover aquatic orgs., birds & mammals, soil orgs., above ground arthropods
  - Aquatic + bird & mammal modules available
  - www.webfram.com
- **CEA delivered above ground arthropod exposure component**

Overall project objectives
NTA exposure

- **Objective 1** – characterise toxicity – SSD's extrapolate from standard spp to other NTA's (Kevin Brown Ecotox Ltd, CSL)
- **Objective 2** – characterise exposure – application, drift, vegetation factors (CEA, Paul Miller SRI/TAG)
- **Objective 3** – integrate 1 & 2 into risk estimates (Tom Aldenberg RIVM)
- **Objective 4** – validation – field trials, develop safety factors
- **Objective 5** – combine into relevant risk assessment module

Current exposure estimates

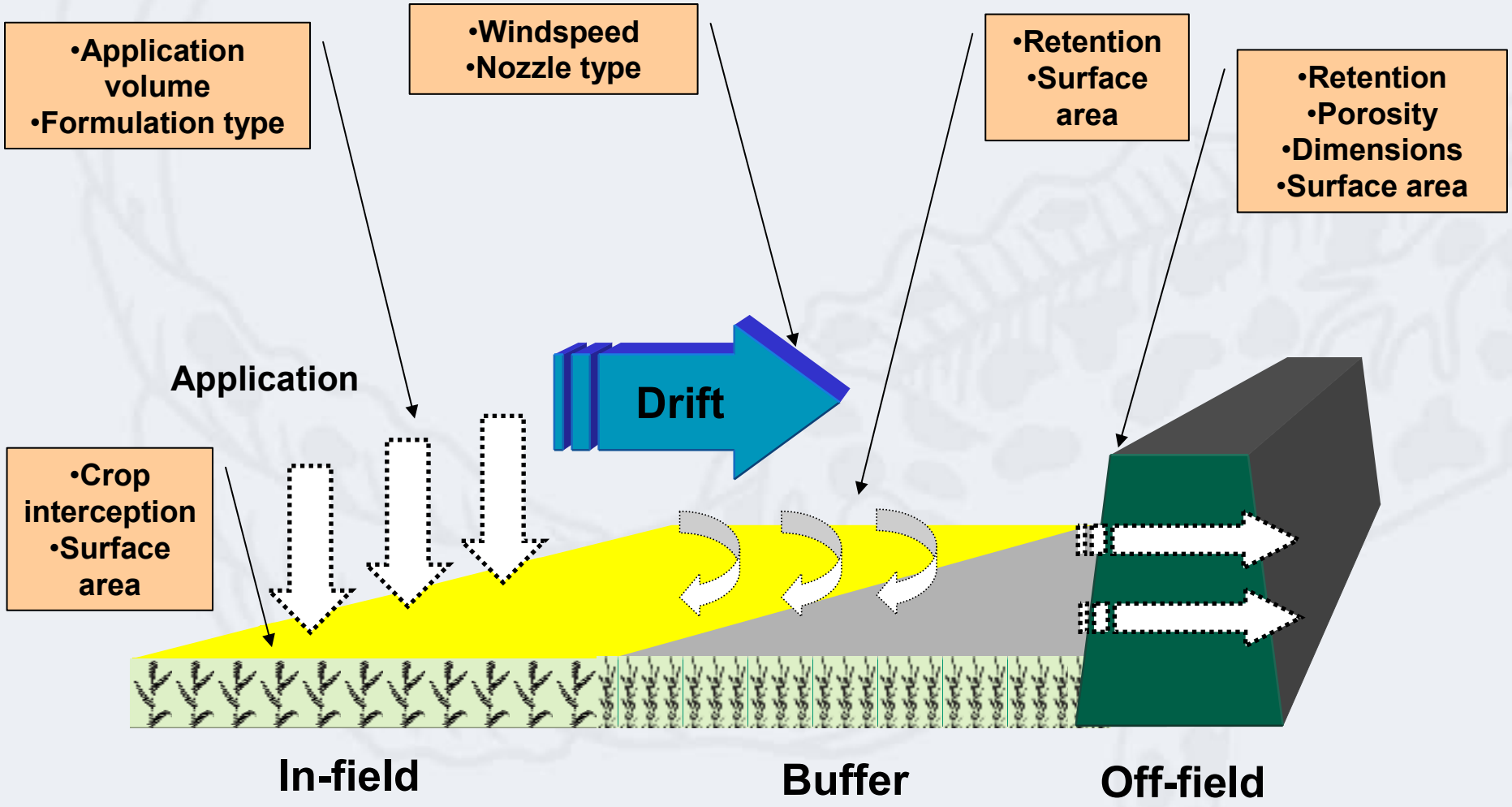
- **In-field**
  - 2-dimensional
  - Exposure = application rate x MAF
  - No account of crop architecture
  - No differentiation between exposure to foliar & soil surface dwelling arthropods



Current exposure estimates

- **Off-field**
  - 2-D deposition drift data – unsuitable
  - 'Vegetation distribution factor' accounts for
    - Interception by off-field foliage
    - Foliar surface area effects
  - No account taken of buffer zones

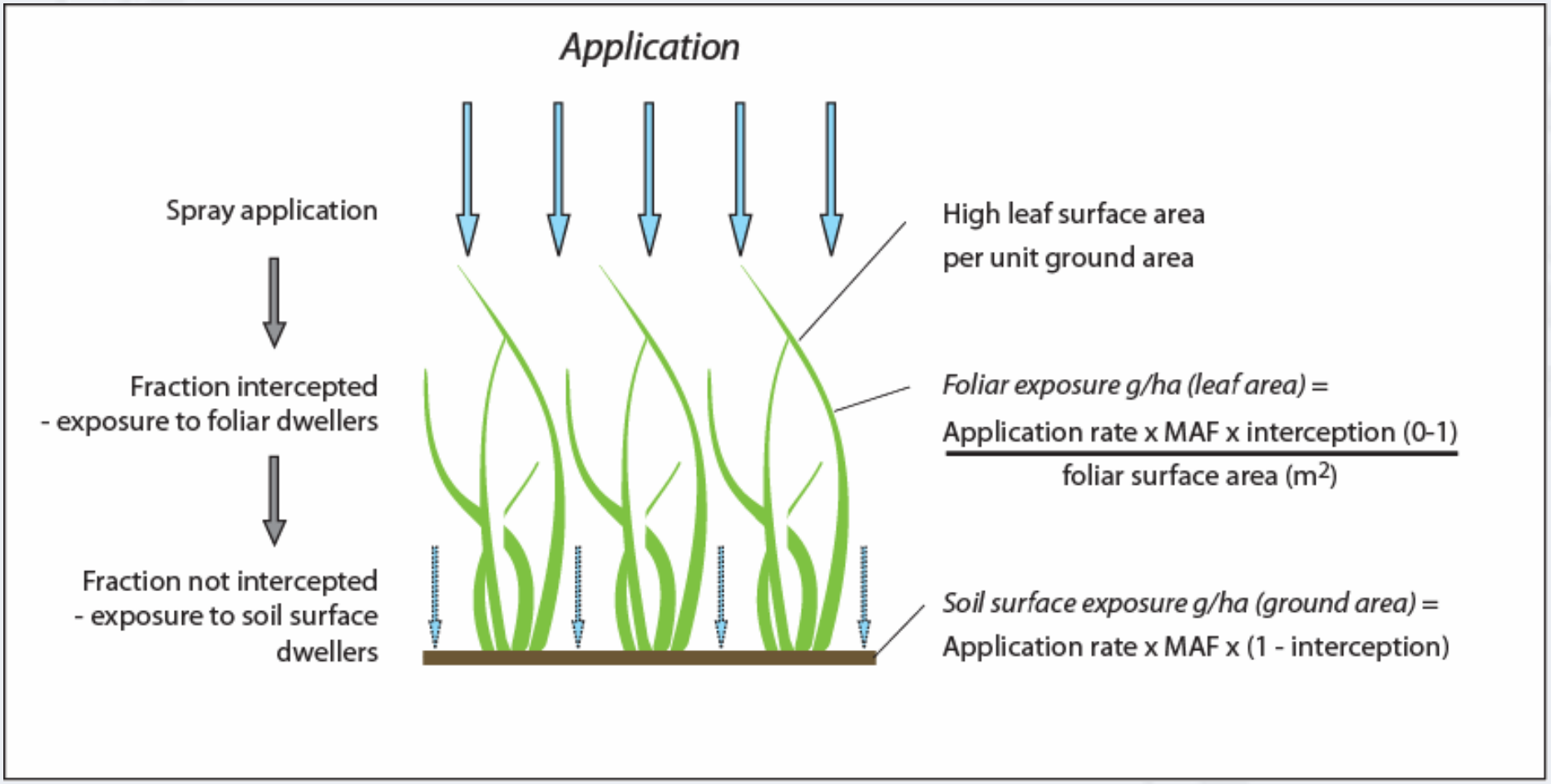
WEBFRAM 4 arthropod exposure schematic



In-field exposure key points of this approach

- **Towards a 3-D environment**
  - Interception of spray by foliage
  - Fraction of application which is not intercepted – soil surface exposure
  - Application to 1 ha land may actually be *x* ha leaf area
  - What effect does leaf area have on exposure?
  - Foliar exposure estimate = average exposure, over entire plant surface
  - Soil surface exposure also included
- **'Reference' application, can be modified by**
  - Application volume
  - Formulation type

Proposed in-field exposure procedure



Crop combinations

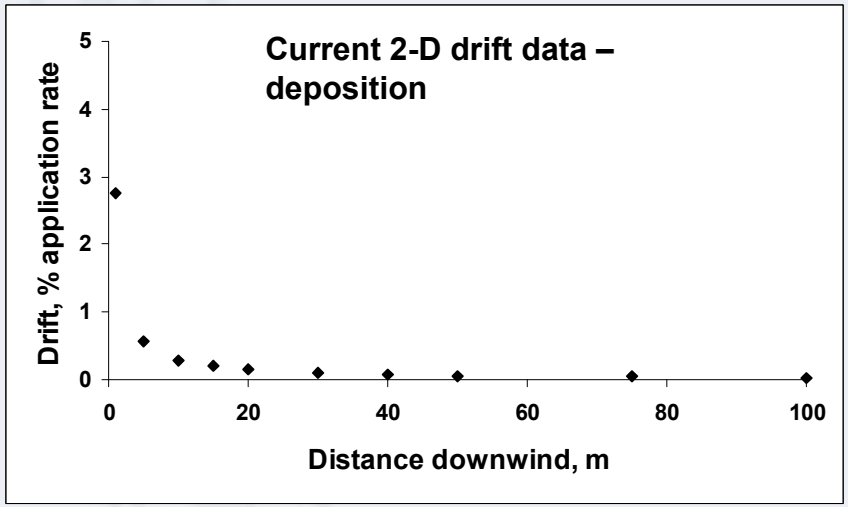
- Crops characterised include cereals, sugar beet, cabbage & oilseed rape

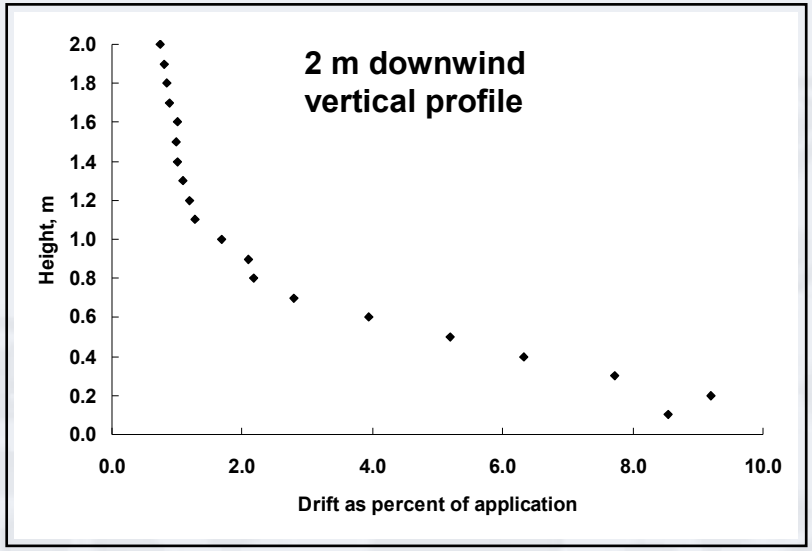
Cereals	Bare - emergence (BBCH 00-09)	Leaf development (BBCH 10-19)	Stem elongation (BBCH 20-39)	Flowering (BBCH 40-89)	Senescence and ripening (BBCH 90-99)
Interception (0-1)	0	0.39	0.89	0.95	0.89
Surface area (m^2)	0.0	1.0	4.5	6.0	4.5

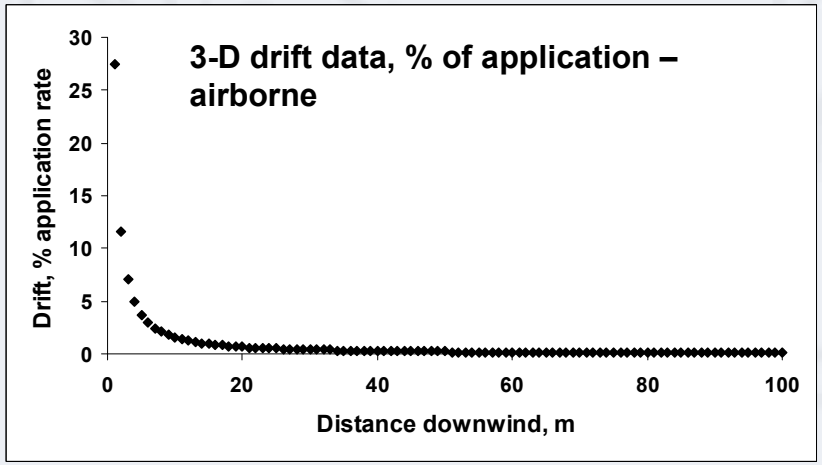
Off-field exposure key points

- **Divided into ‘buffer zones’ and true ‘off-field’**
  - Allows for added realism
  - Attenuation of drift by buffers
  - Inclusion of landscape features
- **Revised drift data**
  - Estimates of drift flux 0-2 m height, up to 100 m downwind
- **Vegetation**
  - Interception and surface area characterised for buffer strips & off-field vegetation

Drift data


Current 2-D drift data – deposition
Drift, % application rate
0
1
2
3
4
5
0
20
40
60
80
100
Distance downwind, m

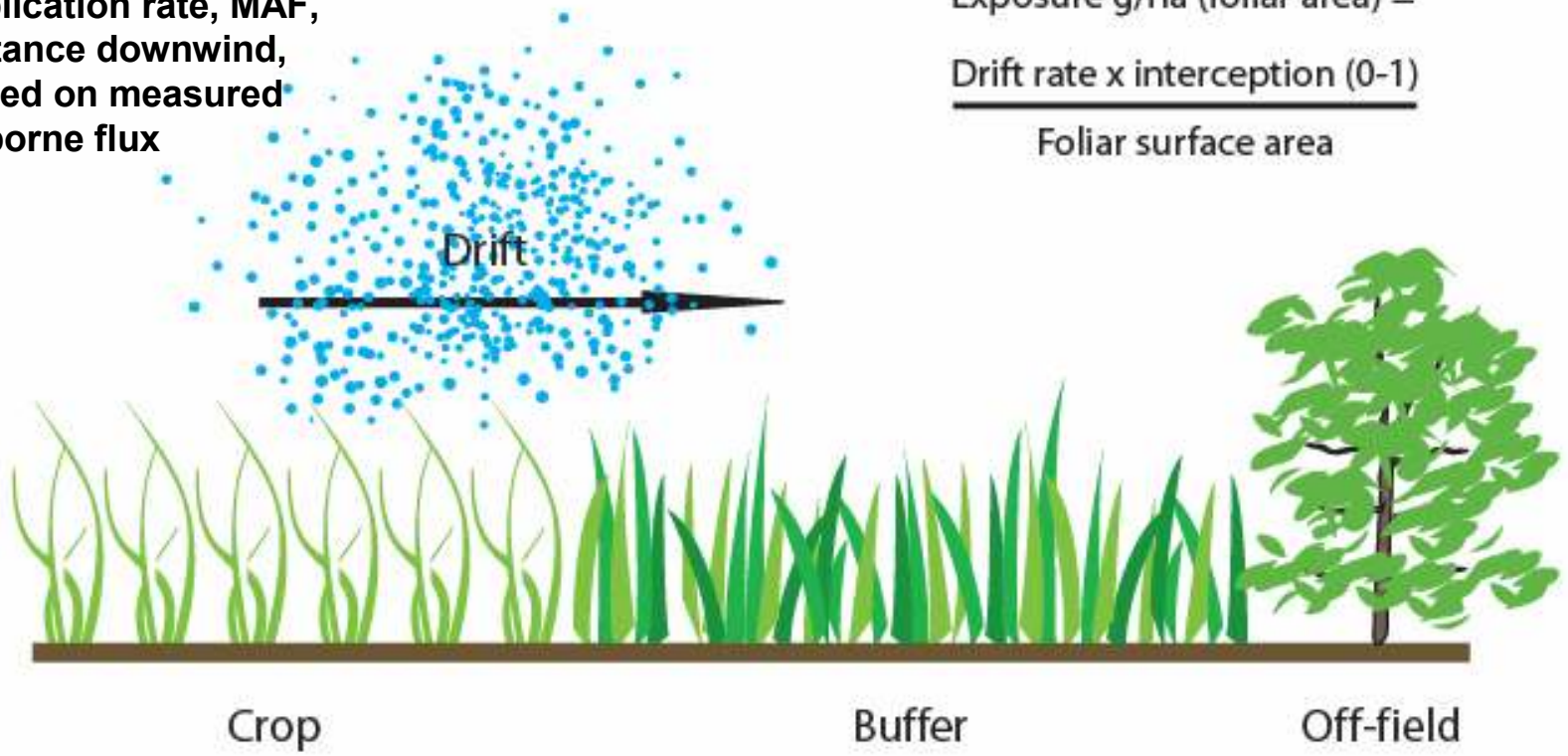

2 m downwind vertical profile
Height, m
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0.0
2.0
4.0
6.0
8.0
10.0
Drift as percent of application


3-D drift data, % of application – airborne
Drift, % application rate
0
5
10
15
20
25
30
0
20
40
60
80
100
Distance downwind, m

Off-field exposure

Drift rate considers application rate, MAF, distance downwind, based on measured airborne flux

$$\text{Exposure g/ha (foliar area)} = \frac{\text{Drift rate x interception (0-1)}}{\text{Foliar surface area}}$$



Alternative exposure?

- **In-field**
  - Factors of foliar interception and surface area are key
    - ESCORT 2: exposure = rate (eg 1000 g as/ha)
    - Alternative: exposure reduced, eg 1000 g as/ha x 0.9 (interception) / 6 (leaf area, m^2) = 150 g as/ha
    - Soil exposure = 100 g as/ha (1000-900)
- **Off-field**
  - Drift rate, interception, surface area
    - Less certain about off-field parameters
    - Concept considered sound
    - Exposure will be dictated by user input values
    - Similar level of protection from alternative approach

Departures from ESCORT 2, limitations

- **In-field environment**
  - Crop architecture (interception/surface area)
  - Towards a 3-dimensional environment
- **Off-field**
  - Now ‘buffer zones’ and ‘off-field’
  - New drift data
  - Off-field vegetation architecture
- **Limitations**
  - Data availability
  - Validation?
  - Orchards?

End use, research needs

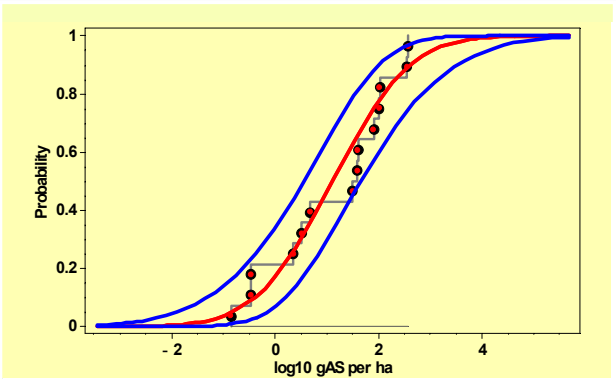
- **End use**
  - An alternative approach
  - Has identified knowledge gaps
  - A basis for a revision of current risk assessment procedures
- **Need to firm up spray & drift assumptions**
  - Spray behaviour, interactions with crop
  - Drift behaviour

End use, research needs, continued

- **Characterisation off-field areas required**
  - Vegetation types, interactions with drift, habitat quality, proximity to cropped area
- **Arthropod community responses to pesticides**
  - Relate arthropod assemblages to off-field vegetation type/region
  - Effects of drift & repeat exposure?

What about effects?
CSL – Ecotox - RIVM

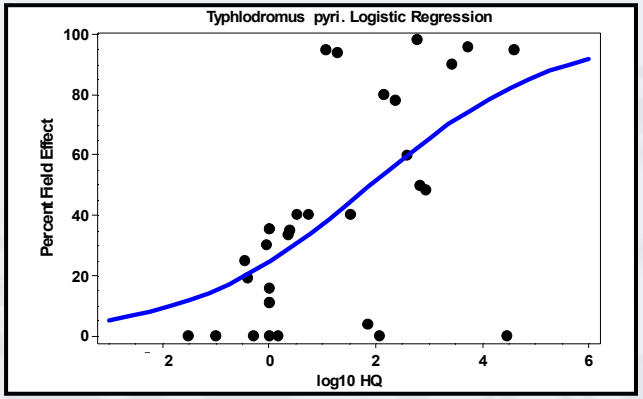
- **SSD approach is not appropriate for non-target arthropod data**
  - Includes species variation in exposure, which differs between lab and field
- **Therefore focus on use of empirical relationships for risk assessment**
  - Calibrate HQ against field data
  - Analogous to the approach used for ESCORT 2

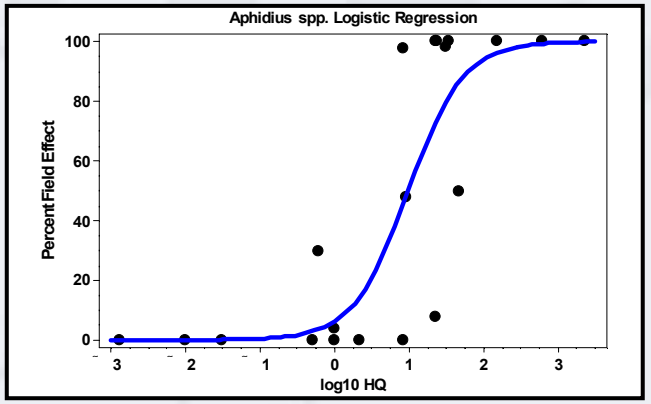


Empirical calibration

- ***T. pyri* and *Aphidius* spp.**
  - Tier 1 to Tier 2 (extended lab tests)
  - Tier 1 to field
- **Extrapolation to other species**
- **Characterise uncertainties**

- **Analysis in progress - will demonstrate principles with the available data**
- **Results due soon**





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Thanks for your attention