Describing off-crop deposition of pesticides via run-off/erosion from treated fields

Science For A Better Life

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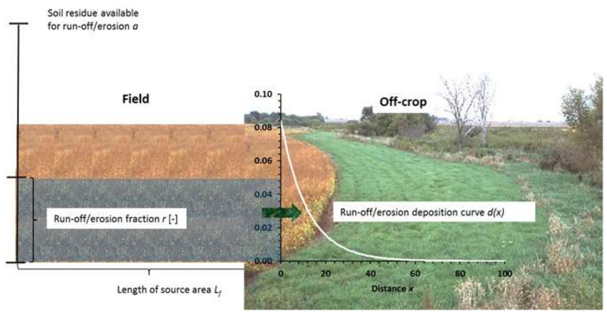
Introduction

- EFSA (2017) soil risk assessment opinion on plant protection products requires to include run-off/erosion entries from treated fields into off-crop areas
- and proposes to use
  - FOCUS surface water STEP 2 run-off/erosion loss percentages combined with
  - 90th percentile retention efficacy values of vegetated filter strips (VFS) which are used for mitigation in FOCUS surface water exposure assessments (FOCUS, 2007)
- in EFSA (2017) the choice of 90th percentile retention efficacy is considered preliminary since these values represent the minimum deposited fractions
- thus EFSA (2017) recommends to re-evaluate the existing information on the efficiency of vegetated buffer strips with regard to worst case situations for off-crop areas



Aim of study

- derive a conceptual framework to describe the deposition of run-off/erosion entries in off-crop areas
- identify the key driving parameters
- explore the sensitivity of off-crop exposure and necessary buffer widths on the driving parameters

Materials and methods

- **source term:** mass m of pesticide moving across the edge of the treated field into the off-crop area

  $\boldsymbol{m = a \cdot r \cdot L_f}$ **[M/L]**

  a residue available for run-off/erosion [M/L^2], (can be considered equivalent to field application rate at lower tier)

  r run-off/erosion loss fraction of a [-]

  L_f length of source area in run-off/erosion flow direction [L])[§]

  [§]due to homogeneity it is sufficient to consider only one dimension

- **deposition shape curve:**: distribution of mass m as function of the distance x from edge-of-treated-field ($d(x)$ [1/L]); area under deposition shape curve is 1 (conservation of mass) :

  $\boldsymbol{d(x) = p \cdot \exp(-p \cdot x)}$ p shape parameter [1/L]

- **off-crop deposition:**

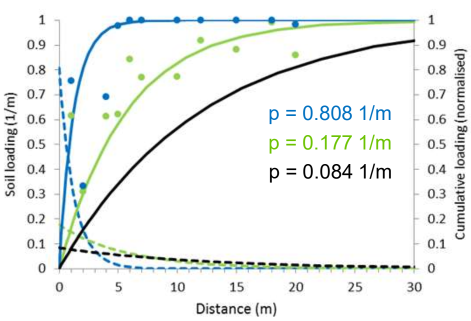
  $\boldsymbol{q(x) = m \cdot d(x)}$ **[M/L^2]**

- **necessary buffer width** b_x as function of off-crop effect endpoint f, normalised to residue a available for run-off/erosion:

  $\boldsymbol{b_x(f) = \max(0, \ln(p \cdot r \cdot L_f / f) / p)}$ **[L]**

Results

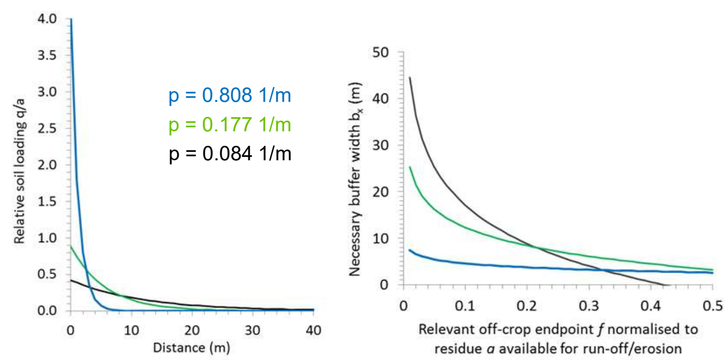
Deposition curves derived from empirical data on efficacy of vegetated filter strips of different width



Empirical (symbols) and fitted cumulative soil loading (solid lines) for mean (green) and maximum (blue) VFS capacity using data from FOCUS (2007; Table 1.8). The black line is the fit to the worst case (low) retention values as proposed by EFSA (2017; Table 29). The dashed lines are the corresponding derived deposition curves

- the greater the retention capacity the larger is the deposition at the edge of the treated field and the lower is the deposition at greater distance
- this can be considered for the off-crop soil risk assessment

Relative soil loading and necessary buffer width to pass risk assessment



Soil loading (relative to field application rate) and necessary buffer width b_x for run-off/erosion loss fraction r = 0.05 (STEP 2) and L_f = 100 m long source area

- soil loading at the edge of the treated field is driven by run-off/erosion mass (source area × loss fraction) leaving the treated field and the shape parameter p
- necessary buffer width to pass off-crop risk assessment is driven by deposition shape curve
- which curve is most conservative varies with distance

Conclusions

- mass lost (size of source area × areic run-off/erosion loss) and shape of the deposition curve are identified as main drivers for off-crop deposition of pesticides
- depending on the parameter selected, deposition can vary substantially from multiples of the field application rate to small fractions of it (if e.g. the source area is smaller), with corresponding impact on the risk assessment
- appropriate parameterisation requires further clarifications (e.g. vulnerability criteria for deposition shape curve) and a thorough review of empirical and modelling data on the generation of run-off/erosion losses

References

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FOCUS (2007). "Landscape And Mitigation Factors In Aquatic Risk Assessment. Volume 1. Extended Summary and Recommendations". Report of the FOCUS Working Group on Landscape and Mitigation Factors in Ecological RiskAssessment, EC Document Reference SANCO/10422/2005 v2.0. 139 pp.