Is it justified to worsen the default wash-off factor for FOCUS modelling?

Science For A Better Life

Gerald Reinken[2], Eduard Hellpointner[1] and Dieter Schäfer[2]

[1]Bayer AG CropScience Division, Environmental Safety – Environmental Fate , D-40789 Monheim, Germany ; [2]Bayer AG CropScience Division, Environmental Safety – Environmental Modelling, D-40789 Monheim, Germany

E-mail contact: gerald.reinken@bayer.com

Introduction

- Recent regulatory interest in the wash-off process has suggested that the effects of wash-off to be generally considered as additional soil loading for FOCUS modelling of foliar applied pesticides (EFSA 2010, 2016).
- EFSA proposed to worsen the existing default wash-off factor for FOCUS modelling from 0.5 cm^{-1} to 1 cm^{-1} (EFSA 2012).
- EFSA has also stated that effects of wash-off should be not considered as worst case rather as average effect (EFSA 2015, 2016).

- **Important Considerations**
  - The foliar wash-off factor is a compound and product (formulation) specific modelling input parameter that can be experimentally determined.
  - The experimental study design and calculation of the wash-off factor needs to be aligned with the implementation of foliar wash-off processes in FOCUS models.

Materials and methods

- **Experimental determination of wash-off factor for modelling purposes**
  - Based on a generic framework of an experimental study design derived in a workshop organised by the European Crop Protection Association (ECPA)
    ➡ Poster A-13 *"Development of a Harmonised Study Design for the Measurement of a Foliar Wash-off Coefficient for use as a Modelling Parameter"*
  - **Experimental study design as well as calculation of the wash-off factor is suitable to derive input for FOCUS PEARL and FOCUS PELMO.**
  - Experiments consider one heavy rainfall invent of 15 mm during an hour applied 24 hrs after foliar pesticide spray.
  - Rainfall application via rainfall simulator
  - Linear calculation of wash-off factor *w*

C_0 *Initial active ingredient concentration in/on plant material after drying period of 24 h and before rainfall*
C_x *Residual active ingredient concentration in/on plant material after rainfall*
q *Rainfall depth*

$$w = \frac{c_0\left[\frac{\mu g}{kg}\right] - c_x\left[\frac{\mu g}{kg}\right]}{c_0\left[\frac{\mu g}{kg}\right] \cdot q\,[cm]}$$

  - Crops (whole plants) selected based on product specific use pattern (GAP)

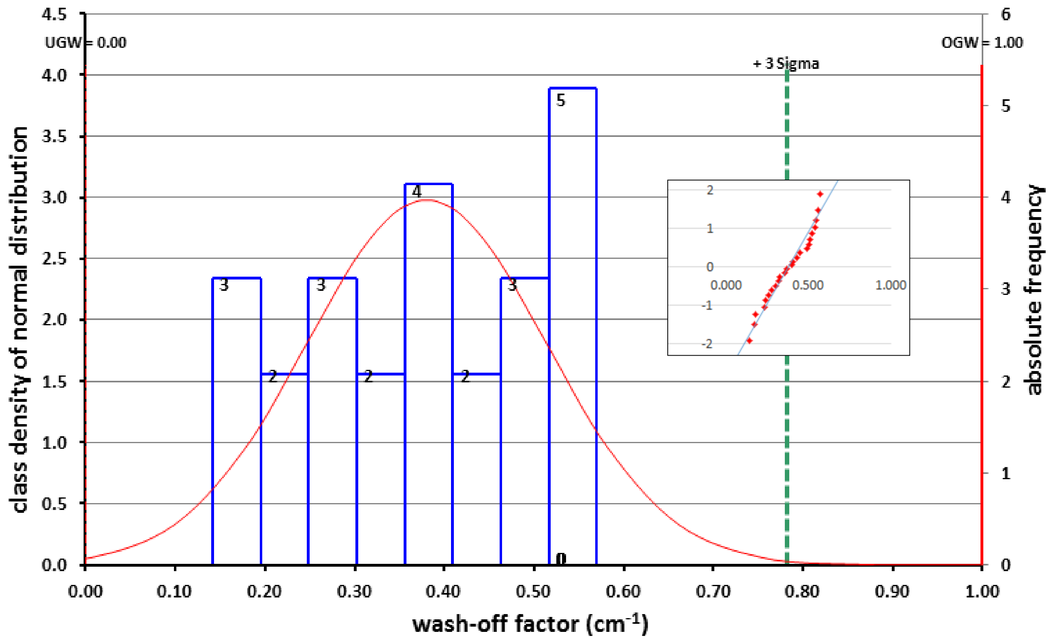
Results

- **Experimental determination of 24 individual wash-off factors**
  - 15 experiments, mainly GLP (9)
  - 11 formulations of 3 main formulations groups (FG, CIPAC codes)
    - FG 1: Soluble concentrates (SL)
    - FG 2: Emulsions / Emulsifiable (EC, EW)
    - FG 3: Particle based / Flowables (SC, SE, WG, WP)
  - 7 compounds (a.i.1 – a.i.7)
  - 6 crops representing 2 leaf surface wettability groups
    - Cassie-Baxter regime (fainty wettable): rape, wheat
    - Wenzel regime (easily wettable): apple, lettuce, strawberry, vine
- **Main Outcome**
  - The determined wash-off factors seems to be normally distributed (Anderson-Darling-Test, normal probability plot).
  - Arithmetic mean (and median) of all single values is 0.38 cm^{-1}.
  - The highest measured wash-off factor is 0.57 cm^{-1} and the lowest 0.14 cm^{-1}.
  - Just 7 of the 24 values are slightly above the existing default wash-off factor of 0.50 cm^{-1}.
  - A wash-off factor of 1.00 cm^{-1} would be clearly outside the 3-sigma range of the experimental data set (see Figure below).

Overview of the wash-off experiments

No.	Laboratory code	Experiment No.	GLP	Formulation	Crop	Compound	wash-off factor (cm^{-1})
1	Lab A	1	No	SC500 a	apple	a.i. 2	0.26
2	Lab A	2	No	WG50	apple	a.i. 1	0.43
3	Lab A	3	No	SL200	apple	a.i. 5	0.51
4	Lab A	4	No	SL200	lettuce	a.i. 5	0.56
5	Lab B	5	No	SC500 b	lettuce	a.i. 2	0.49
6	Lab B	5	No	SC500 b	lettuce	a.i. 1	0.36
7	Lab B	6	No	SE250	rape	a.i. 2	0.24
8	Lab B	6	No	SE250	rape	a.i. 3	0.45
9	Lab C	7	Yes	WG50	apple	a.i. 1	0.32
10	Lab C	8	Yes	WG50	vine	a.i. 1	0.37
11	Lab C	9	Yes	WG50	strawberry	a.i. 1	0.57
12	Lab C	10	Yes	SC400	apple	a.i. 2	0.18
13	Lab C	10	Yes	SC400	apple	a.i. 6	0.14
14	Lab B	11	Yes	EC260	wheat	a.i. 4	0.33
15	Lab B	11	Yes	EC260	wheat	a.i. 2	0.28
16	Lab B	11	Yes	EC260	wheat	a.i. 3	0.55
17	Lab B	12	Yes	EC225	wheat	a.i. 4	0.30
18	Lab B	12	Yes	EC225	wheat	a.i. 3	0.54
19	Lab C	13	Yes	EW250	wheat	a.i. 6	0.40
20	Lab C	14	Yes	SC325	wheat	a.i. 1	0.17
21	Lab C	14	Yes	SC325	wheat	a.i. 3	0.51
22	Lab C	14	Yes	SC325	wheat	a.i. 7	0.41
23	Lab C	15	Yes	WG75	apple	a.i. 6	0.52
24	Lab C	15	Yes	WG75	apple	a.i. 1	0.24
				Minimum	**0.14**	**Mean**	**0.38**
				Maximum	**0.57**	**Median**	**0.38**

Frequency histogram with class density distribution of experimentally determined foliar wash-off factors (N=24)



Conclusions / Outlook

- **Based on the experimental evidence it may be questioned if it is justified to increase the existing default wash-off factor.**
- Outcome should be confirmed based on a broader data set.
- Evaluation of a comprehensive literature reseach on experimental wash-off studies is ongoing. Goal is to derive from the published data a wash-off factor that is suitable FOCUS modelling.
- Keeping the existing default value of 0.5 cm^{-1} should retain a sufficient protection level while at the same time preventing the evaluation of a unnecessary number of experimental refinement studies.

References

EFSA 2010: PPR opinion 1442 - Outline proposals on exposure of organisms in soil
EFSA 2012: Scientific Opinion 2562 – Science behind the guidance on soil scenarios
EFSA 2015: Guidance Document 4093 - Predicting environmental concentrations in soil
EFSA 2016: Updated Guidance Document on PECsoil (draft)