Impact of the Rainfall Criterion in the EFSA Soil Persistence Guideline on Kinetic Evaluation of Field Degradation Trials

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Abstract

In 2010 the EFSA published a new guidance on soil persistence for the derivation of field half lives of pesticides with the aim to exclude loss processes at the soil surface (i.e. photolysis, volatilisation) . As a pragmatic approach it is proposed that only sampling points after 10 mm cumulative rainfall should be used to derive $DegT_{50}$ ensuring that fast initial processes on surfaces are not taken into account for kinetic evaluation of field studies. As there is no clear scientific basis for the selected 10 mm, we evaluated which impact the selection of this criterion has on kinetic analysis of field studies from different locations across Europe. The impact of the rainfall criterion on the resulting $DegT_{50}$ depends on both, study location and time of application, whereas changing the criterion (to 5, 15, 20 mm) did not show a pronounced effect on the kinetic evaluation.

Introduction

EFSA supposes that the major amount of a compound is displayed to deeper soil layers after 10mm of cumulative rainfall. We evaluated 29 field trials with 5 substances considering rainfall criterions of 5, 10, 15 and 20 mm to answer the questions below:

- Are there any regional or seasonal impacts?
- Does the criterion influence the length of the $DegT_{50}$ or the kinetic type?
- Is there one step in the decision tree kicking off most of the studies?

Materials and Methods

Rainfall data for the field trial sites were obtained from the MARS database (JRC 2012) assigning the trials to either Central Europe (C-EU, n=20) or Southern Europe (S-EU, n=7). First, it was determined if the average amount of weekly rainfall corresponds to the rainfall criterion of 10 mm as supposed by the EFSA and after how many days the rainfall criterion was reached. Further on, the application timing was compared in order to assess a potential seasonal effect of the rainfall criterion.

Substance data were taken from Draft Assessment Reports (EFSA webpage) and weather data from the MARS database. The time-step normalized dataset was evaluated in KinGUI I. For further evaluation of the influence of the rainfall criterion on the length of the $DegT_{50}$ and the type of the kinetic only results with a reliable $DegT_{50}$ were taken into account. For comparison of the steps in the decision tree the whole dataset of 29 field studies (with all replicates for each criterion) was evaluated.

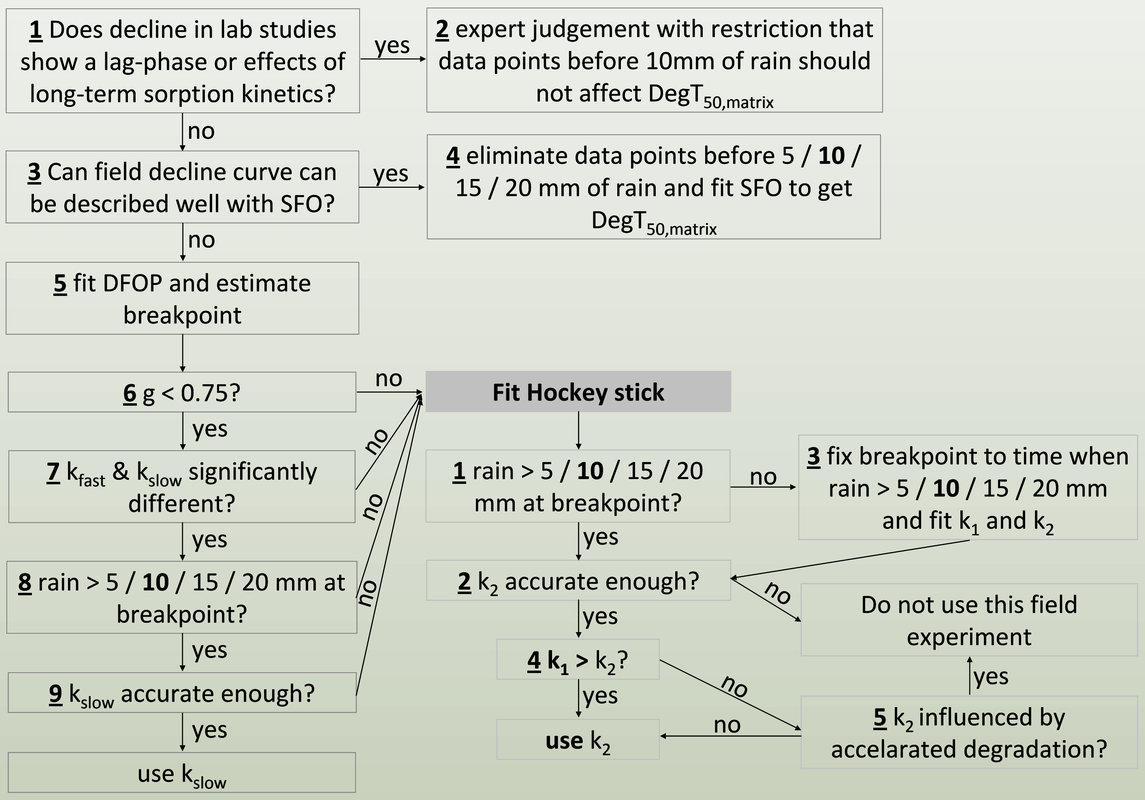

Fig. 1: Decision tree as proposed by the EFSA

Results and Discussion

The arithmetic mean of weekly rainfall during the first four weeks after application was 10 mm. As the standard deviation was greater than the arithmetic mean, the median was regarded to be more appropriate. The median values were 9 mm (C-EU) and 6 mm (S-EU) showing that the criterion of 10 mm (EFSA) applies well for C-EU. Comparing data on a regional background, a huge difference between C- and S-EU becomes apparent (Fig. 2).

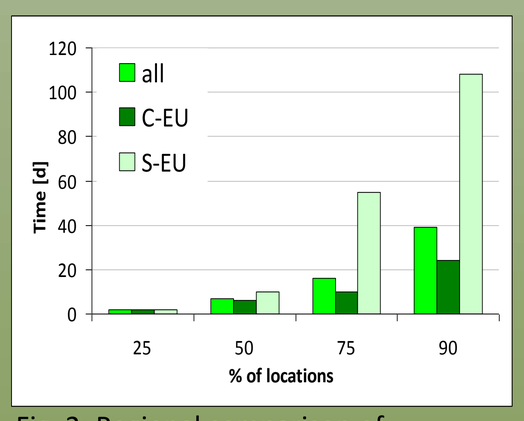

Fig. 2: Regional comparison of duration until 10 mm cum. rainfall are reached

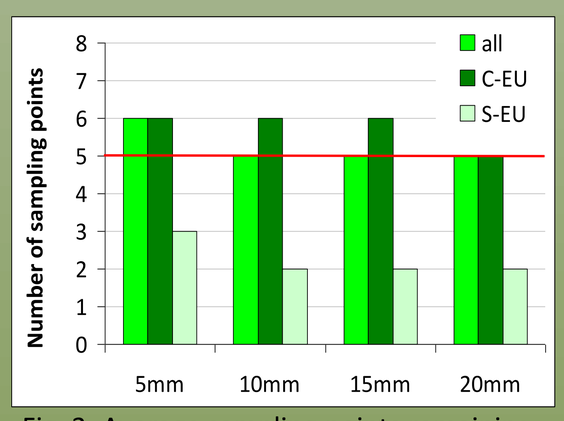

Fig. 3: Average sampling points remaining after reaching the rainfall criterion

The 10 mm rainfall criterion is reached for whole / C- / S-EU after 7 / 6 / 10 days (50% locations), 16 / 10 / 55 days (75% locations) and 39 / 24 / 108 days (90% locations). In June (n=6) the rainfall criterion is reached earlier than in May (n=8) or in August/September (n=6). The average number of all sampling points was 8 (n=29). In all cases (all data, C and S EU) the first 4 sampling points (50%) are within the first 4 weeks. Excluding sampling points before 10 mm rainfall, 5 data points remain (6 for the data of C-EU, 2 for S-EU, Fig. 3).

A similar tendency is observed for rainfall criteria of 5, 15 and 20 mm. In S-EU, more sampling points are expected to be included in the 'fast' first degradation phase which is representative for the actual DegT50 in soil as the rainfall criterion is reached later as in C-EU.

No clear influences of the criterion on the length of the estimated $DegT_{50}$ were observed. In 85% of the cases (n = 58) the $DegT_{50}$ values resulted in the same value regardless of which rainfall criterion was chosen. 5% of the evaluated studies showed shorter $DegT_{50}$ values with increasing rainfall criterion, 10% showed longer $DegT_{50}$ values. This is reasonable, as in most cases, DFOP or HS kinetics were adequate (Fig. 4) and therefore, no cut off of the data set was necessary. 71% of the studies did not pass the third box of the decision tree (SFO). The main reason, why DFOP and HS did not pass was that the slow phase (k_2 or k_{slow}) was not accurate enough (Fig. 5).

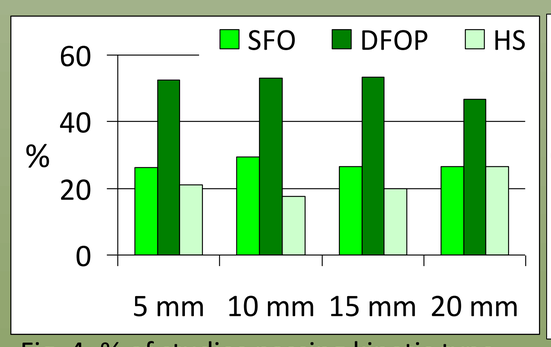

Fig. 4: % of studies passing kinetic type for different rainfall criterions

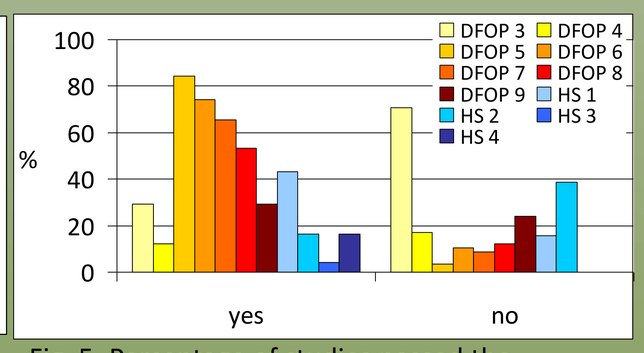

Fig. 5: Percentage of studies passed the decision tree boxes with ‚yes' or ‚no'

Conclusion & Outlook

Analysis of the rainfall data showed that the rainfall criterion as chosen by the EFSA (10 mm of cumulative rainfall) applies well to Central European conditions. With respect to trial sites located in South Europe the rainfall criterion is often reached late so that a reliable $DegT_{50}$ could not be estimated. In C-EU, also a seasonal impact on the time until reaching the rainfall criterion could be stated: it is reached faster in June, slower in May and slowest in late summer/early autumn. With respect to the regional and seasonal impact on the rainfall criterion, further evaluations might be needed, e.g. for trial sites in N-EU. The applicability and the validity of the rainfall criterion for S-EU should be reassessed.

References

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