Modelling concentrations of PPP in ground water after spray application to hop

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Abstract

Hop is not available as crop in the FOCUS groundwater models. In this study we tested if it is necessary to consider the singularity of a crop for the registration of a pesticide or if it is possible to use one of the existent FOCUS crops as a surrogate. Calculations were performed for the non-FOCUS crop hop using hop specific data (e.g. LAI) derived from field measurements. All calculations were done in the same way for all FOCUS crops and in addition the available FOCUS crops combined with the emergence and harvest dates of hop. Our results affirmed that a worst crop covering all situations cannot be defined. However, conservative tier 1 calculations for hop can be done by FOCUS crop maize using the hop emergence and harvest dates and neglecting crop interception.

Introduction

Currently the use of the risk envelope approach is discussed by applicants and authorities to maximise the value of the registration documents. With respect to ground water calculations the possibility for a reasonable crop grouping is supposed to be limited (SANCO/11244/2011). This could be confirmed by several test calculations, e.g. Gimsing *et al.* 2013, Nickisch & Seiterle-Winn 2013, [1,2]. Supported by these results it seems to be essential to calculate the use in each crop. However, the crop selection in the FOCUS ground water models is limited. For example hop is missing though the crop is implemented in the surface water models and at least nine noteworthy productive areas can be found in the EU. The biggest area with ~ 20.000 ha can be found in Germany. Moreover, hop is a special crop because of an extensive leaf development which can result in leaf area index values (LAI) greater than all other crops implemented in the FOCUS models.

Material & Methods

New Crop Hop

Calculations were conducted for the FOCUS scenario Kremsmünster which reflects best the soil & climate conditions of the hop growing regions in Europe. Two application dates were tested for hop and all FOCUS crops: Emergence and Emergence + 60 days. Emergence and harvest dates for hop were set to the $FOCUS_{SW}$ crop dates (15th April, 1st September). Crop parameters like LAI were derived from evaluation of field experiments with three hop varieties at three BBCH stages (37, 55 and 75) conducted by the LFL '*Bayerische Landesanstalt für Landwirtschaft*", see Table 1). At the end three LAI sets were tested (minimum, maximum, average). Two test substances were used: FOCUS A and FOCUS D available in FOCUS PEARL.

Table 1. LAI sets used for hop modelling

BBCH	Set Minimum	Set Maximum	Set Average
37	0.41	0.88	0.58
55	1.94	3.78	2.86
75	3.65	8.96	5.59

Surrogate Crop for Hop

Calculations for the FOCUS crops were conducted as suggested by the FOCUS Working Group on SW Scenarios (2012), but emergence and harvest dates of the FOCUS crops were exchanged with the hop application dates (15th April, 1st September). All other parameters were not changed. This was done to test if a FOCUS crop can be used as surrogate crop for hop.

Results & Discussion

Calculations affirmed that a reasonable grouping of crops does not seem to be possible. The crop order regarding worst case groundwater concentrations varies with the application date as well as the substance properties (see Table 2). Whereas a few crops seem to be conservative for our few simulations runs (e.g. winter oilseed rape), other crops showed ambiguous results (e.g. potatoes). Results for hop showed that LAI is positively correlated with ground water concentrations. As expected, the influence of LAI increased with later application dates. This result is higher than average concentrations for the emergence + 60 days runs.

Table 2. Comparison of groundwater concentrations after application of 1 kg a.s./ha to the soil surface ; emergence / harvest = FOCUS dates

FOCUS D Emergence		FOCUS D Emergence + 60 days		FOCUS A Emergence + 60 days	
Crop	**PEC [µg/L]**	**Crop**	**PEC [µg/L]**	**Crop**	**PEC [µg/L]**
woilseed rape	1.017	woilseed rape	0.984	**HOP LAI-MAX**	7.487
wcereals	0.808	**HOP LAI-MAX**	0.600	woilseed rape	7.180
apples	0.650	wcereals	0.566	**HOP LAI-AVG**	6.988
vine	0.556	maize	0.546	maize	6.572
strawberry	0.502	**HOP LAI-AVG**	0.522	apples	6.485
HOP LAI-MAX	0.352	potatoes	0.507	**HOP LAI-MIN**	6.418
grass	0.344	sugarbeet	0.489	sugarbeet	6.375
scereals	0.327	fieldbeans	0.444	wcereals	6.216
HOP LAI-AVG	0.284	**HOP LAI-MIN**	0.439	scereals	5.941
fieldbeans	0.268	onions	0.380	potatoes	5.845
maize	0.259	apples	0.375	fieldbeans	5.759
HOP LAI-MIN	0.228	scereals	0.354	vine	5.616
carrots	0.213	vine	0.319	onions	5.518
onions	0.212	cabbage	0.306	cabbage	5.256
sugarbeet	0.211	strawberry	0.261	strawberry	5.049
potatoes	0.202	grass	0.203	grass	4.802
cabbage	0.174	carrots	0.174	carrots	4.743

Calculations considering the hop emergence and harvest dates for all FOCUS crops showed that LAI has a considerable influence on ground water concentrations (see Figure 1). For example Hop-average showed higher concentrations than the FOCUS crops. Only maize showed PEC_{GW} in the same range.

Our calculations were conducted with the same soil load. In practice, the high LAI values of hop will be reflected by high model interception values. We assume that the difference between hop and maize will be much smaller than the difference between application rate and soil load. Thus, tier 1 calculations could be done with maize considering hop crop dates but neglecting crop interception.

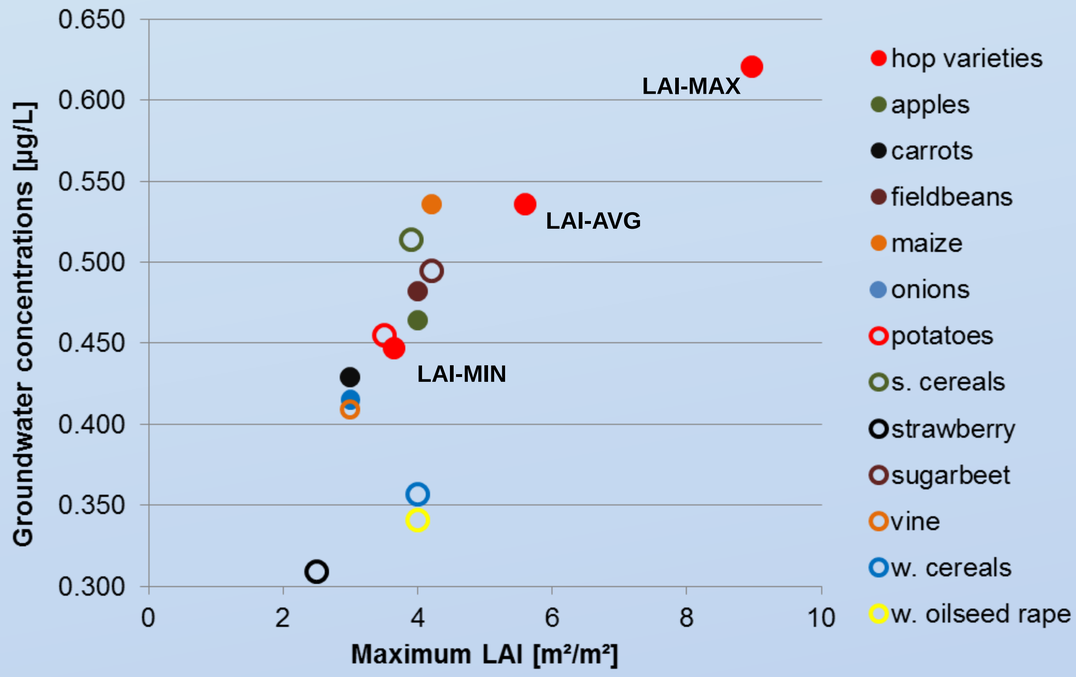

Figure 1: PEC_{GW} for hop and all FOCUS crops considering hop emergence and harvest dates (15th April, 1st September) for all crops, substance FOCUS D, 1 kg a.s./ha soil load

Conclusion

Calculations affirmed that a risk envelope for PECs in ground water is not trivial. However, it could be shown that the main drivers next to substance parameters are crop parameters. Thus, a conservative tier 1 risk estimation for hop can be done by neglecting crop interception and selecting an annual FOCUS crop with constant high LAI values like maize in combination with emergence and harvest dates of hop.

References

[1] Gimsing, A. *et al.* 2013, The first steps towards simplifying the Northern Zone groundwater requirements, 23rd SETAC Europe Meeting, Glasgow

[2] Nickisch D. & Seiterle-Winn, N. 2013, Risk Envelope Approach: Applicable for PEC groundwater calculations?, 23rd SETAC Europe Meeting, Glasgow