SELECTING APPLICATION DATES FOR UK HIGHER TIER DRAINFLOW MODELLING: COMPARING THE FOCUS AND CRD PESTICIDE APPLICATION TIMING RULES

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Introduction

Pesticide losses *via* drainflow are strongly dependent on the soil moisture status at the time of application and the rainfall pattern that follows application. For drainflow simulations, the choice of application date can therefore have a significant influence on predicted environmental concentrations. To standardise the selection of application dates, the FOCUS surface water models include a calculator tool, the Pesticide Application Timer (referred to hereafter as FOCUS PAT), which selects an application date from a window defined by the user, applying a set of rules to the daily rainfall data used in the simulation. These rules were originally designed to ensure a realistic worst-case risk assessment within the 16 month assessment period considered for the FOCUS drainflow scenarios (FOCUS, 2001).

Alternative criteria for selecting application dates for drainflow simulations were proposed by Brown et al. (2004) and incorporated into a modelling tool developed recently by the HSE's Chemicals Regulation Division (CRD) for performing UK higher tier (HT) drainflow (DF) risk assessments using the MACRO model. Under these rules (referred to hereafter as CRD PAT) a different set of criteria is applied to the daily rainfall data for each of 30 years, with the algorithm selecting the first compliant date on or after a particular target day. Prior to the release of this new HSE tool, the use of FOCUS PAT within UK HT DF risk assessments was widespread.

Aim

This study seeks to explore the difference in risk assessment outcomes between the two PAT approaches through consideration of (i) annual maximum Predicted Environmental Concentrations in surface water (PECsw) and (ii) numbers of simulation years failing the risk assessment.

Methodology

MACRO simulations were conducted using the recently-released HSE UK HT DF risk assessment approach for two crops (winter cereals and potatoes), two application timings (pre- and post-emergence), two PAT approaches (CRD and FOCUS) and four FOCUSsw test compounds with varying soil half life and adsorption characteristics:

1 - K_{foc} 15 mL/g; DT_{50} 6d

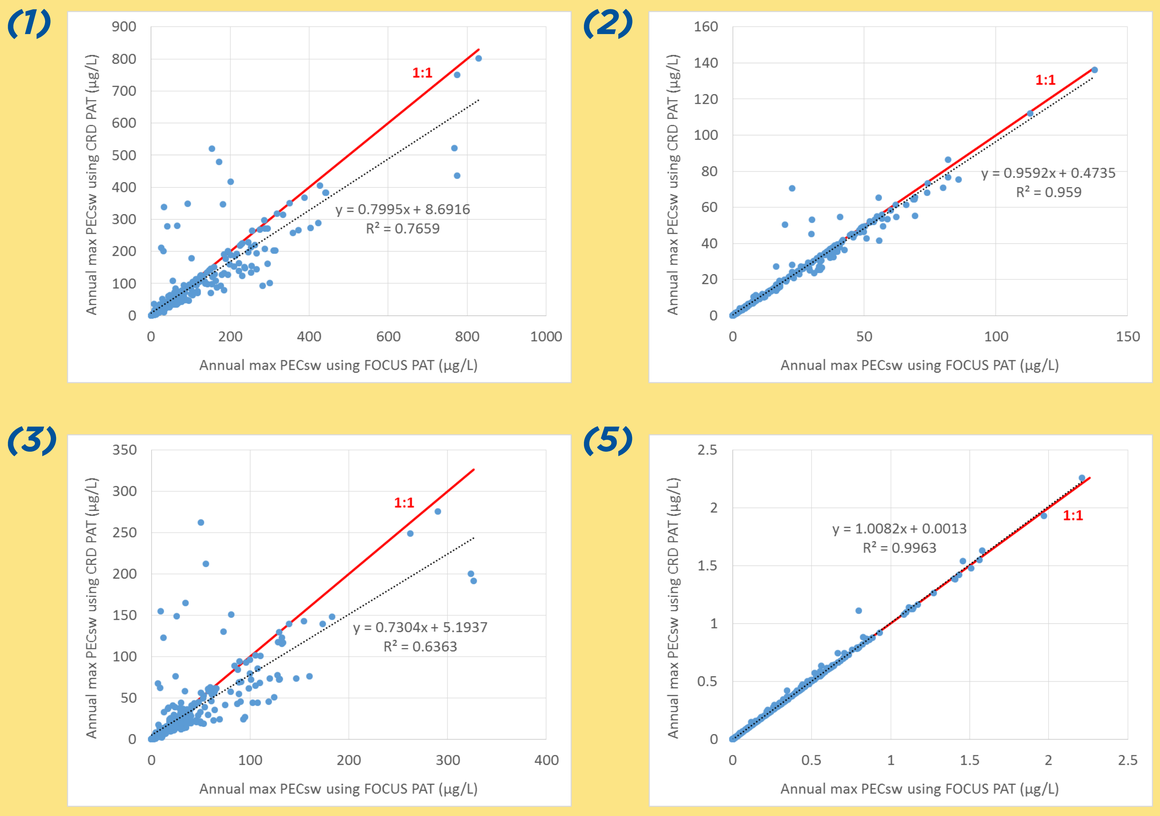
2 - K_{foc} 91 mL/g; DT_{50} 43d

3 - K_{foc} 1 mL/g; DT_{50} 4d

5 - K_{foc} 860 mL/g; DT_{50} 250d

Annual application dates, annual maximum PECsw and numbers of years exceeding the regulatory acceptable concentration (RAC) were summarised and analysed. A comparison of the annual maximum PECsw generated using the FOCUS PAT approach with equivalent PECsw generated using the CRD PAT approach is given in Figure 1 for post-emergent application to winter cereals.

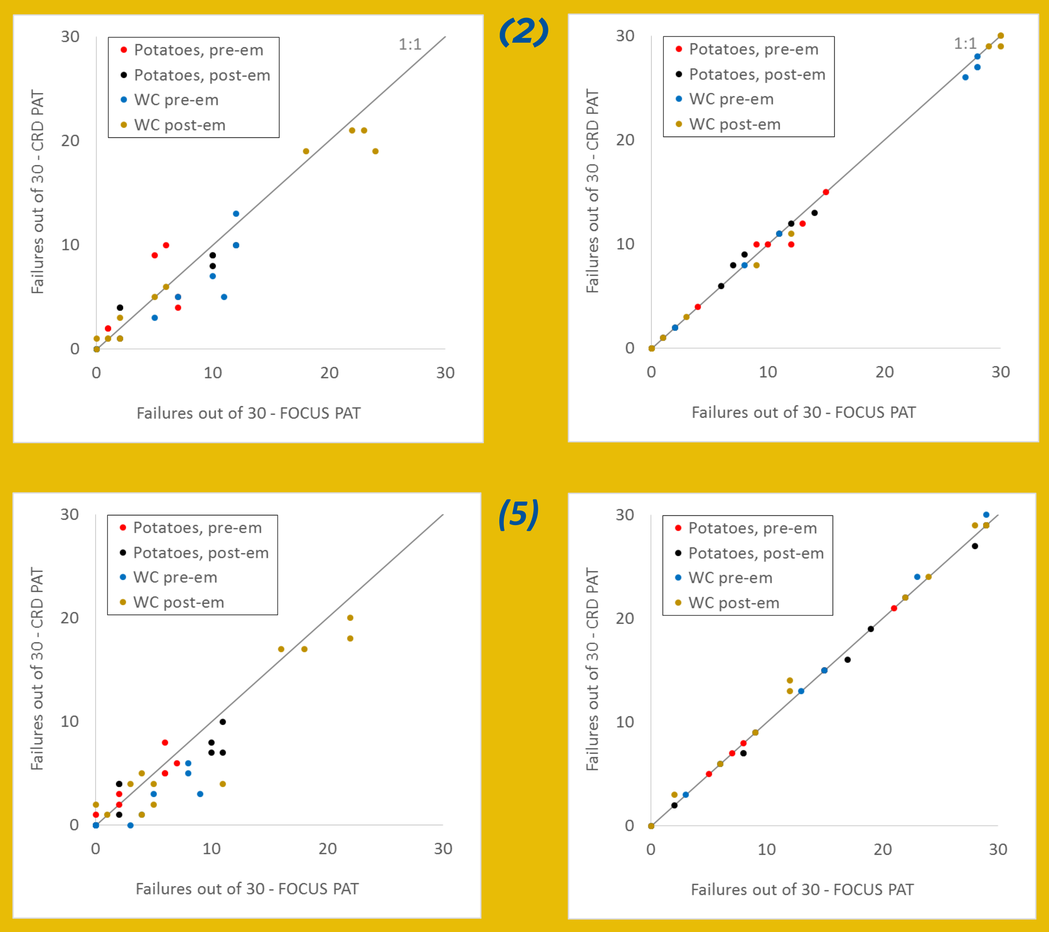
Figure 1 ***Comparison of PAT approaches considering annual max PECsw for a post-emergent application to winter cereals for the four FOCUS compounds***



Results

The maximum PECsw results indicate that the difference between the two PAT schemes is more pronounced for mobile and short-lived compounds (1 & 3), with the FOCUS PAT rules appearing to produce more conservative results overall. This pattern is also observed when the number of annual failures in each of the 30 years is considered (Figure 2).

Figure 2 ***Number of annual failures for all crops for each of the FOCUS compounds***



The FOCUS PAT rules selected an application date that was, on average, 8 days later than the CRD PAT scheme, which appeared to select application dates very close to the intended target date. Analysis of the FOCUS PAT rules used to select these dates indicated that the dominant criteria applied were as follows:

- ≥ 10 mm rainfall in total in the 10 days following application
- < 2 mm of rain each day in a 5 day period starting 2 days before application and ending 2 days after application

By contrast, the CRD rules do not specify a minimum amount of rainfall in the days following application, although they do potentially permit a greater amount of rainfall in the days immediately before and after application:

- < 200 mm rainfall the day before application
- < 2 mm rainfall on the day of application
- < 7 mm rainfall on each of the two days following application

This comparison provides an explanation for the differences observed in maximum PECsw and numbers of failed simulation years.

Conclusions

- The timing of pesticide applications is a key input determining the number of annual RAC exceedances as well as the magnitude of these exceedances.
- The differences in outcome between the CRD and FOCUS PAT schemes are largely a function of their approaches, with the FOCUS PAT rules originally designed to select a realistic worst-case application date within a specified window in a single representative year, while the CRD PAT rules were designed to target a particular application date, deviating from this date only if required to avoid unduly conservative rainfall and soil moisture conditions in multi-year simulations.
- Since FOCUS PAT selects realistic worst-case dates in each of the 30 simulation years, it may be less realistic overall than the CRD PAT scheme with regards to application date selection when used for long-term simulations such as those modelled via the UK HT DF tool.

References:
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