VALIDATION AND REFINEMENT OF CROP DEVELOPMENT DATES USED IN PESTICIDE EXPOSURE MODELLING AND RISK ASSESSMENT:

Collation and analysis of regulatory field trial data

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Background Determining appropriate pesticide application windows is an important component of surface water (SW), groundwater (GW), and soil pesticide exposure modelling. These application windows are coming under increased scrutiny from European regulators. The current method for estimating an application window is to use the software tool AppDate which provides date estimates for BBCH crop growth stages. The AppDate software[1, 2] calculates application dates for use in FOCUS modelling with the purpose of aligning the product GAP being assessed with predefined model crops described by the FOCUS models. The dates for major crop development stages, e.g., BBCH 30, captured in AppDate are based on various sources, differentiated for GW and SW, with linear interpolation used for in-between growth stages. Given exposure assessments are sensitive to the application dates this software generates, it is important to understand how realistic they are. Although phenology datasets are available (*e.g.* http://www.pep725.eu/), there is currently no comprehensive, quality-controlled, readily available, pan-European crop phenology dataset available to undertake such an assessment or for use in regulatory risk assessment refinement.

Methodology CropLife Europe have funded a 2-year project (2021 – 2022) to collate a harmonised crop development database for Europe, from product efficacy and residue field trials held by individual members. The compiled database would then be analysed by comparing the pairs of reported BBCH growth stages and assessment dates verses the application date and BBCH growth stages output by AppDate. Cereals data is being used to trial the data harmonisation and analysis approach and are presented in the results section.

Results Efficacy trial datasets have been sourced from 7 members and a harmonised crop development dataset created. The data collection process has highlighted that residue trial datasets are not typically stored in a format that makes them easily combined with the efficacy trials datasets. The harmonised database:

- Spans two decades (2000-2020)
- Comprises >250 crops (combinable, top/soft fruit, pasture/grass, ornamentals, vegetables and herbs amongst others) and
- Covers 25 EU Member States, 3 EEA countries as well as Switzerland and the UK.

Considering the cereals (spring and winter) data which have been analysed:

- A small number of countries contribute the majority of the data (Figure 1) , largely from the central regulatory zone (Table 1)
- There is temporal bias (Figure 2) with the majority of the data generated in the last 10 years.
- Most focus scenarios (Table 2) have a good representation, although some are under-represented e.g. Jokioinen winter cereals, Porto and R2 spring cereals.
- D5 winter cereals (Figure 3a) indicate BBCHs < 23 occur in spring and autumn.
- D1 spring cereals (Figure 3b) indicates sparse data available in the key BBCHs < 23.

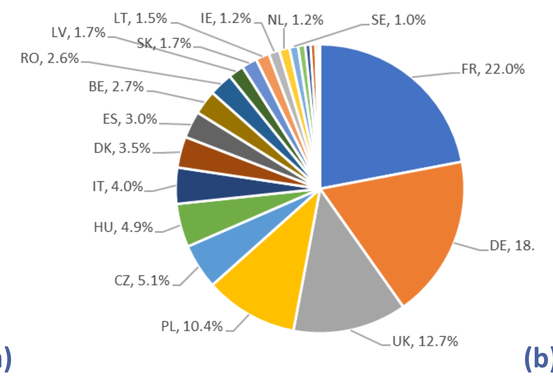


Figure 1: Percentage of (a) winter and (b) spring cereals data contributed by each country.

Table 1: Regulatory zone summary of cereals records in the collated dataset

Regulatory Zone	Cereals, spring	Cereals, winter	Cereals, spring	Cereals, winter	Total
Northern	29.0%	7.9%	3.3%	6.9%	10.3%
Central	57.3%	61.4%	6.6%	54.3%	60.9%
Southern	13.6%	30.8%	1.6%	27.2%	28.8%
Total	100.0%	100.0%	11.5%	88.5%	100.0%

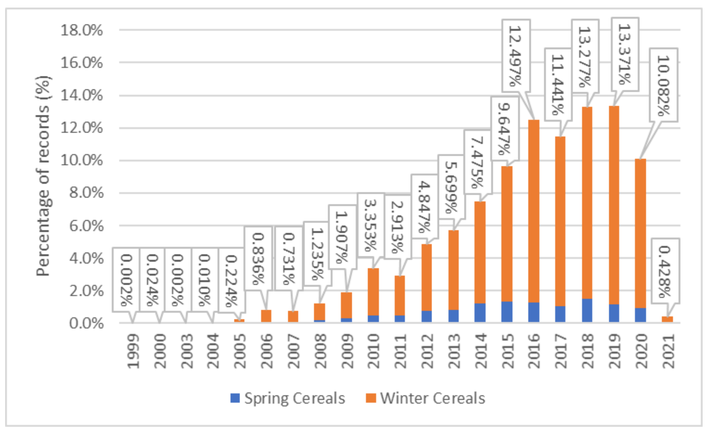
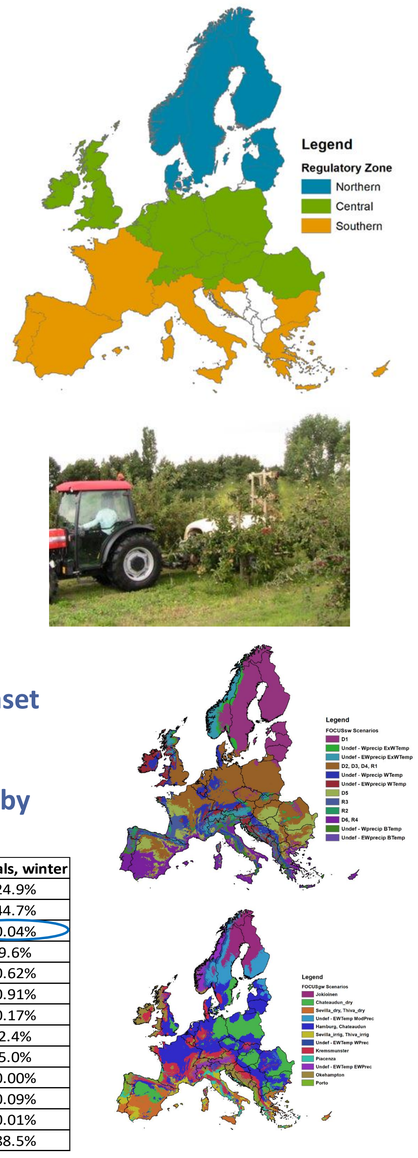


Figure 2: Annual summary of cereals records in the collated dataset

Table 2: Percent of winter and spring cereal data within each FOCUSsw and FOCUSgw scenario as well as climate not covered by these.

FOCUSsw Scenario	Cereals, spring	Cereals, winter	FOCUSgw Scenario	Cereals, spring	Cereals, winter
D1	2.6%	3.9%	Chateaudun (non-irrig)	3.3%	24.9%
D2 D3 D4 R1	6.9%	56.3%	Hamburg Chateaudun	6.4%	44.7%
D5	0.82%	11.6%	Jokioinen	0.27%	0.04%
D6 R4	0.23%	5.2%	Kremsmunster	0.75%	9.6%
R2	0.07%	0.18%	Okehampton	0.11%	0.62%
R3	0.14%	2.6%	Piacenza	0.06%	0.91%
Undef EWPrecip BTemp	0.00%	0.07%	Porto	0.01%	0.17%
Undef EWPrecip ExWTemp	0.004%	0.05%	Sevilla & Thiva (non-irrig)	0.11%	2.4%
Undef EWPrecip WTemp	0.05%	0.52%	Sevilla & Thiva (Irrig)	0.29%	5.0%
Undef WPrecip BTemp	0.05%	0.72%	Undef EWTemp EWPrecip	0.00%	0.00%
Undef WPrecip ExWTemp	0.05%	0.04%	Undef EWTemp ModPrecip	0.18%	0.09%
Undef WPrecip WTemp	0.58%	7.3%	Undef EWTemp Wprecip	0.00%	0.01%
Total	11.5%	88.5%	Total	11.5%	88.5%



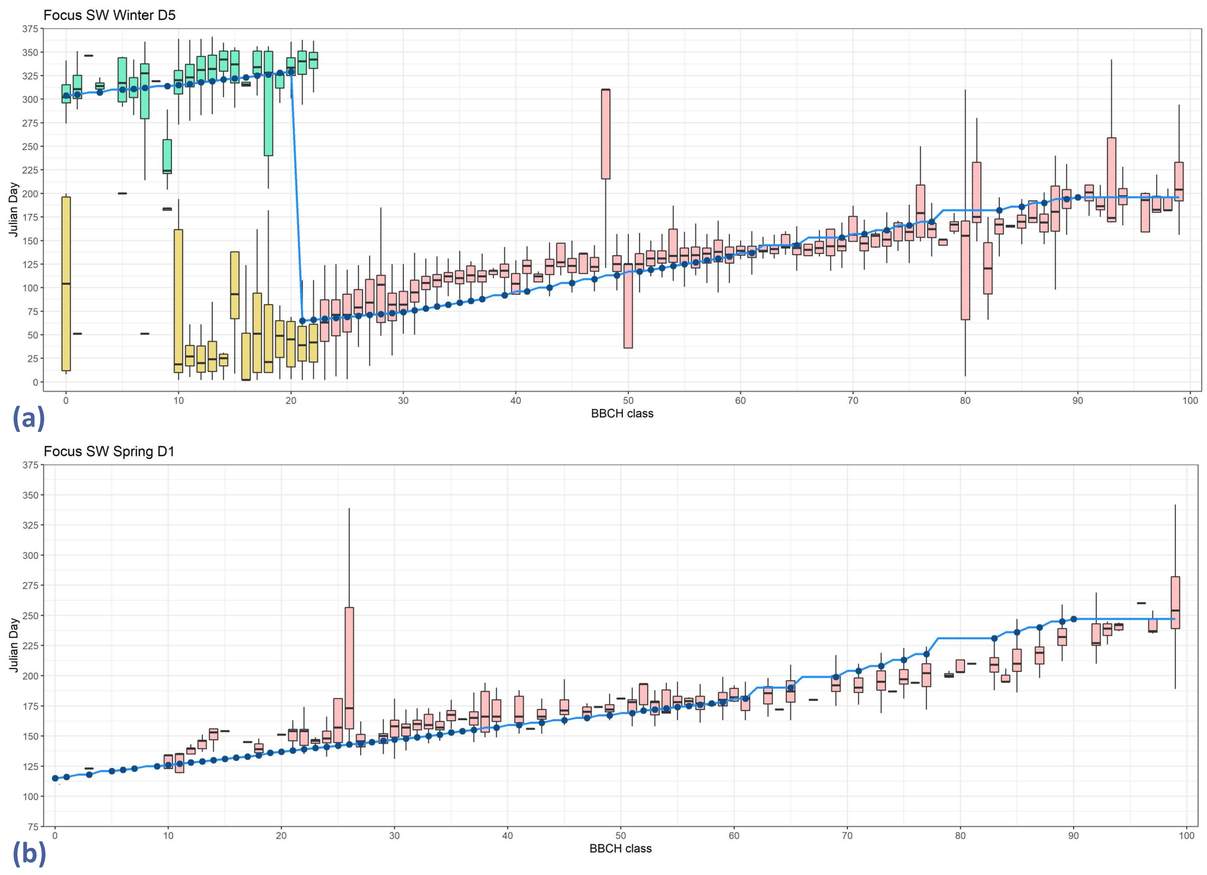


Figure 3: Example comparisons of the AppDate BBCH growth stages (blue dots = recognised growth stages) and the data collated within the CropLife Europe dataset (excluding outliers) for (a) D5 winter cereals and (b) D1 spring cereals. The early BBCH stages of (a) were separated into spring and winter distributions using a Julian day of 200.

CONCLUSIONS AND NEXT STEPS

The database developed: (i) has sufficient records that an assessment of the recommended crop development dates in AppDate for a range of FOCUS scenarios, crops and development dates can be facilitated, although some will likely be under-represented; (ii) holds significant opportunities for future development of crop models to improve estimates and timing of exposure, not only in the context of exposure modelling, but also, for example, to help predict accurate timing of applications with respect to on and off-field weeds and non-target arthropods, especially bees.

Following the cereals crops used to trial the approach, the remaining combinable crops will be processed by summer 2022, the permanent tree/cane crops by autumn 2022 and horticultural/vegetable crops by the end of the project in late 2022.

References:
1 Klein, M., 2012. Estimation of reasonable application dates dependent on BBCH crop development stages for PELMO (all FOCUS groundwater locations). Report Umweltbundesamt. Fraunhofer IME Schmallenberg. 30pp.
2 Klein, M., 2018. Estimation of consistent application dates dependent on BBCH crop development stages for FOCUS models. Fraunhofer IME Schmallenberg. 42pp.