

# The Danish Pesticide Leaching Assessment Programme

**MONITORING RESULTS**  
**MAY 1999 - JUNE 2022**



**Geological Survey of Denmark and Greenland**  
Department of Geochemistry

**Aarhus University**  
Department of Agroecology  
Department of Ecoscience



# The Danish Pesticide Leaching Assessment Programme

Monitoring results May 1999–June 2022



Nora Badawi, Sachin Karan, Eline B. Haarder, Lasse Gudmundsson, Carl H. Hansen, Carsten B. Nielsen, Finn Plauborg, and Kirsten Kørup

Geological Survey of Denmark and Greenland  
Danish Ministry of Climate, Energy and Utilities

Department of Agroecology  
Aarhus University

Department of Ecoscience  
Aarhus University



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Geological Survey of Denmark and Greenland  
Øster Voldgade 10, DK-1350 Copenhagen K, Denmark  
Phone: +45 3814 2000  
E-mail: [geus@geus.dk](mailto:geus@geus.dk)  
Homepage: [www.geus.dk](http://www.geus.dk)

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## Preface

In 1998, the Danish Parliament initiated the Danish Pesticide Leaching Assessment Programme (PLAP), which is an intensive monitoring programme aimed at evaluating the leaching risk of pesticides under field conditions. The Danish Government funded the first phase of the programme from 1998 to 2001. The programme has now been prolonged several times, initially with funding from the Ministry of the Environment and the Ministry of Food, Agriculture and Fisheries for the period 2002 to 2009, and then from the Danish Environmental Protection Agency (EPA) in the period 2010 to 2018. Additionally, funding for establishing a new test field, designated to be included in the monitoring programme for 2016-2018, was provided in the Danish Finance Act for the fiscal year of 2015. The establishment of the new test field was, however, delayed and not initiated until the autumn of 2016. In April 2017, PLAP received funding until 2021 via the Pesticide Strategy 2017-2021 set by the Danish Government, and this funding was recently prolonged via the Pesticide Strategy 2022-2026.

The work was conducted by the Geological Survey of Denmark and Greenland (GEUS), the Department of Agroecology (AGRO) at Aarhus University, and the Department of Ecoscience (ECOS) at Aarhus University, under the direction of a management group comprising Nora Badawi (GEUS), Kirsten Kørup (AGRO), Sachin Karan (GEUS), Eline B. Haarder (GEUS), Steen Marcher (Danish EPA) and Signe Bonde Rasmussen (Danish EPA).

Maria Sommer Holtze (Danish EPA) chairs the steering group, and the members are Per Kudsk (AGRO), Claus Kjølner (GEUS), and the project leader Nora Badawi (GEUS). Kirsten Kørup (AGRO) and Steen Marcher (Danish EPA) are substitutes, and Sachin Karan is the secretary.

This report presents the results for the period May 1999–June 2022 with a focus on the leaching risk of pesticides applied during the monitoring period July 2020–June 2022. Some pesticides are monitored within this period but were applied in 2018-2019 and these will also be evaluated. Previous results were reported annually with one year of overlap, but this present report covers results for two reporting periods continuing from the last report (Badawi *et al.* 2022). In addition, the current report layout is changed so pesticide tests are no longer evaluated based on fields individually, instead, all pesticides are evaluated individually covering all fields included in the test (Chapter 6). All reports covering results from previous years and links to associated peer-reviewed articles are available at [www.plap.dk](http://www.plap.dk).

The report was prepared jointly by Nora Badawi (GEUS), Sachin Karan (GEUS), Eline B. Haarder (GEUS), and Kirsten Kørup (AGRO) with contributions from Lasse Gudmundsson (GEUS), Carl H. Hansen (GEUS), Finn Plauborg (AGRO), and Carsten B. Nielsen (ECOS).

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Nora Badawi

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## Summary

In 1998, the Danish Parliament initiated the Pesticide Leaching Assessment Programme (PLAP), an intensive monitoring programme aimed at evaluating the leaching risk of pesticides and/or their degradation products under field conditions. The objective of PLAP is to improve the scientific foundation for decision-making in the Danish regulation of pesticides by enabling field studies to be included in the risk assessment of selected pesticides. The specific aim is to evaluate whether approved pesticides applied in accordance with current regulations and maximum permitted dosages according to crop and BBCH stages, under actual, Danish field conditions can result in leaching of the pesticides and/or their degradation products to the groundwater in concentrations exceeding the limit value of 0.1 µg/L for groundwater and drinking water.

This report focuses on results from the period July 2020 – June 2022. During this period, 21 different products containing a total of 20 different active ingredients were applied to the PLAP fields as part of the agricultural management. Not all active ingredients from these products were selected for testing and therefore not included in the monitoring or presented in this report.

We here present the results of tests carried out on five different fields, of which one is sandy (Jyndevad) and the other four consist mainly of clay till (Silstrup, Estrup, Faardrup, Lund). Additionally, it should be noted that several active ingredients were applied to the fields before July 1, 2020, for which either the active ingredient, degradation product/s, or both were included in the monitoring. In the evaluation of the individual test, we have therefore included the results of analyses before July 2020 in cases where this was needed. A summary of the results is given in Table 0.1 for samples collected from April 2018 to 30 June 2022. In the current report, we present either preliminary or final results of the testing of 21 active ingredients (for simplicity hereafter referred to as *pesticides*), of which four pesticides and a total of 35 degradation products were included in the monitoring. The pesticides were applied to the PLAP fields by spraying 21 different commercial products. In some cases, the commercial products contained one or more pesticides, and in other cases, the same pesticide was applied to the fields using different commercial products.

Please refer to Table 8.1 and Table 8.2 for a historical perspective of the entire monitoring in PLAP from 1999–2022, which has so far included 156 pesticides and/or degradation products (53 pesticides and 103 degradation products). Detailed information and results of previous tests can be found in previous PLAP reports (e.g. Badawi *et al.* 2022 and other reports available at [www.plap.dk](http://www.plap.dk)).

Table 0.1. Summary for samples collected from April 2018 to 30 June 2022. Four pesticides and 35 degradation products (39 analytes) were analysed in PLAP from July 2020 to June 2022. 27 compounds not previously evaluated in PLAP are marked in red. VZ is variably saturated zone (drains and suction cups), SZ is saturated zone (vertical and horizontal groundwater screens), and irrigation is number of analysed irrigation water samples. Concentrations in irrigation water are presented in brackets in units of µg/L. Det. is detections > 0.01 µg/L and Max conc. is maximum concentration.

Pesticide	Analyte	Number of samples			Results of analysis					
		VZ	SZ	Irrigation	Variably saturated zone			Saturated zone (groundwater)		
					Det.	> 0.1 µg/L.	Max conc. µg/L	Det.	> 0.1 µg/L.	Max conc. µg/L
Acetamiprid	IM-1-4	54	211	6 (-)	0	0	-	0	0	-
	IM-1-5	54	211	6 (-)	0	0	-	0	0	-
Azoxystrobin	CyPM	58	257		43	9	0.21	36	3	0.23
Cyazofamid	CCIM	54	211	6 (-)	0	0	-	0	0	-
	CTCA	54	211	6 (-)	0	0	-	0	0	-
	DMSA	54	211	6 (0.02)	11	6	2.1	60	38	0.78
	N,N-DMS	54	211	6 (0.03)	42	13	0.39	80	43	0.44
Cycloxydim	BH 517-T2SO2	70	257	1 (-)	0	0	-	0	0	-
	EZ-BH 517-TSO	70	250	1 (-)	16	1	0.11	37	0	0.05
Florasulam	5-OH-florasulam	119	260		8	1	0.35	0	0	-
	DFP-ASTCA	119	260		0	0	-	0	0	-
	DFP-TSA	119	260		0	0	-	0	0	-
	TSA	196	652		1	0	0.06	0	0	-
Fluopyram	Fluopyram	95	284	2 (-)	19	1	0.21	4	0	0.02
	Fluopyram-7-hydroxy	53	137	2 (-)	2	0	0.01	0	0	-
Halauxifen-methyl	X-729	87	237		0	0	-	0	0	-
Metconazole*	Metconazole	61	109		1	0	0.01	0	0	-
Picloram	Picloram	28	140		1	0	0.01	1	0	0.05
Propaquizafop	CGA287422	73	193		0	0	-	0	0	-
	CGA290291	73	193		0	0	-	0	0	-
	CGA294972	73	193		0	0	-	0	0	-
	PPA	74	193		0	0	-	0	0	-
Propyzamide	Propyzamide	127	390		29	11	7	21	4	0.22
	RH-24580	26	128		0	0	-	0	0	-
	RH-24644	26	128		2	1	0.11	0	0	-
Proquinazid	IN-MM671	94	294	8 (-)	0	0	-	0	0	-
	IN-MM991	94	294	8 (-)	0	0	-	0	0	-
Pyroxulam	5-OH-pyroxulam	119	260		1	0	0.04	0	0	-
	6-Cl-7-OH-pyroxulam	119	260		0	0	-	0	0	-
	7-OH-pyroxulam	119	260		1	0	0.04	0	0	-
	PSA	119	260		4	2	0.25	0	0	-
	Pyridine sulfonamide	119	260		0	0	-	0	0	-
Tebuconazole Prothioconazole Difenoconazole (SD)** Epoxiconazole Propiconazole	1,2,4-triazole *	473	1,475	14 (-)	404	119	0.47	811	26	0.22
Thifensulfuron-methyl	IN-B5528 ***	94	216	2 (-)	0	0	-	0	0	-
	IN-JZ789	41	79		0	0	-	0	0	-
	IN-L9223	41	79		0	0	-	0	0	-
Thiophanate-methyl	Carbendazim	123	343	10 (-)	3	0	0.02	0	0	-
Tribenuron-methyl ***	IN-R9805	53	137	2 (-)	0	0	-	0	0	-
	M2	53	137	2 (-)	0	0	-	0	0	-

\* 1,2,4-triazole is also a degradation product from metconazole

\*\* SD: Seed Dressing. Difenoconazole was only applied as seed dressing

\*\*\* IN-B5528 is also a degradation product from tribenuron-methyl

## Highlights for compounds included in the monitoring period July 2020–June 2022

The following sections summarize the results of the pesticide tests presented in Chapter 6.

### Acetamiprid

Acetamiprid was tested in a potato crop at Jyndevad in 2020. None of the two degradation products, IM-1-4 and IM-1-5, were detected in water from the suction cups, groundwater, or irrigation water, neither before the acetamiprid application (from April to June 2020) nor in the monitoring period from June 2020 to July 2022. In conclusion, IM-1-4 and IM-1-5 do not give rise to groundwater detections above the limit value during the present monitoring period, but the monitoring is ongoing and a final evaluation will be presented in the following PLAP report.

### Azoxystrobin

Azoxystrobin was tested in Silstrup on winter wheat in May/June 2020 and its degradation product CyPM was included in the monitoring. The maximum CyPM concentration in all monitoring wells occurred in October 2020 corresponding to 5 months after the first azoxystrobin application. Exceedance of the limit value in three wells was also observed in October 2020 after which no detections of CyPM concentrations > 0.1 µg/L occurred. A similar pattern was observed in the maximum drainage concentration, which coincided with the maximum concentrations observed in the groundwater wells. The overall leaching pattern of CyPM is similar in drainage and groundwater samples with relatively high concentrations found 5 months after azoxystrobin application and following the first major drainage event. The subsequent slow decrease in concentration seen in drainage samples, however, does not correspond to the pattern seen in groundwater samples, as the concentrations here decline rapidly and continue to be far below the limit value for the rest of the monitoring period. This indicates that CyPM, although detectable in the drainage, does not leach to the groundwater, perhaps due to further degradation. A total of 201 samples were collected in drainage and groundwater during the monitoring period. CyPM was detected in 76 of these and in 12 samples in concentrations > 0.1 µg/L. The CyPM detections > 0.1 µg/L were found in nine drainage samples out of 50 drainage samples and in three out of 151 groundwater samples.

### Azoles including metconazole

In line with previously published PLAP monitoring reports (e.g., Badawi *et al.* 2022), 1,2,4-triazole continued to be detected at all monitored PLAP fields. Likewise, the current evaluation confirmed that the concentration in which 1,2,4-triazole was detected varied considerably among the monitored fields. For instance, exceedance of the limit value was detected continuously in Estrup for relatively long periods (around six months); in Silstrup merely on two occasions; and in Faardrup, no detection above the limit value occurred. Still, there were some generally consistent patterns of the 1,2,4-triazole leaching at the clay till fields: High concentrations in the variably saturated zone (drainage) were followed by relatively high detections in the groundwater monitoring wells and vice versa. This contrasted with the sandy field, where detected concentration levels decreased over time in the variably saturated zone. The EFSA conclusion on tebuconazole (EFSA, 2014), states that azoles are known to accumulate in the plough layer, and with recent knowledge of azoles also being used in seed dressing (Albers *et al.*, 2022), it is acknowledged that the 1,2,4-triazole detections cannot be directly linked to a specific azole application. Because azoles have been used in the PLAP fields several times since 2014, and the use of azole-coated seeds was not registered before 2017, the presence of accumulated azoles in the PLAP fields is likely and could be the cause of the continuous degradation of azoles into 1,2,4-triazole, which leads to long-term leaching to groundwater.

### **Cyazofamid**

Cyazofamid was applied on Jyndevad in a potato crop from June to September 2020 and four of its degradation products, CCIM, CTCA, DMS, and DMSA, were included in the monitoring. DMS and DMSA were generally detected in concentrations  $> 0.1 \mu\text{g/L}$  and over long periods (approximately 6-12 months) in groundwater wells. In these periods, the DMS- and DMSA concentrations exceeded the limit value by a factor of 2-4, while individual measurements exceeded the limit value by up to a factor of 8. Further, there was a consistent pattern of DMSA being detected earlier in groundwater below the field than DMS, and the first breakthroughs of the two degradation products in concentrations  $> 0.1 \mu\text{g/L}$  generally occurred approximately one year after the first cyazofamid application. The results showed that the duration (pulse) of detections is longer for DMS than for DMSA, although the maximum detected concentrations of DMSA are higher than for DMS. Results from suction cells at 1 mbgs, representing flow from the field down to the groundwater, supported the results from the groundwater wells. Thus, analyses from 1 mbgs showed that DMS and DMSA leach in concentrations  $> 0.1 \mu\text{g/L}$ , that DMS and DMSA were found 2-3 months after the first cyazofamid application, and that the duration of DMSA detections was shorter than for DMS. The degradation products CCIM and CTCA were not detected in any of the samples collected.

### **Cycloxydim**

Cycloxydim was tested in winter rapeseed at Silstrup in September 2018 and two of its degradation products, BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO, were included in the monitoring. None of the degradation products were detected in water from drainage or groundwater in the background samples before the cycloxydim application. The first weeks after the cycloxydim application, the groundwater table was below drain depth, preventing drainage sampling, but E/Z BH 517-TSO was detected in drain samples when the drainage started approximately one month after the application. In groundwater, E/Z BH 517-TSO was detected 14 days after the cycloxydim application. E/Z BH 517-TSO was once detected in a concentration  $> 0.1 \mu\text{g/L}$  in a drainage sample from November 2018. Compared to the maximum drainage concentration, the concentration of E/Z BH 517-TSO peaked in groundwater one month later in December 2018 ( $0.058 \mu\text{g/L}$ , H1). E/Z BH 517-TSO was last detected in drainage in August 2019 and groundwater in June 2019, while the monitoring continued to October 2020. The relatively fast detections of E/Z BH 517-TSO (with concentrations generally  $< 0.1 \mu\text{g/L}$ ), in both drainage and groundwater, after cycloxydim application, suggests that E/Z BH 517-TSO is further transformed relatively fast to such an extent that the limit value is not exceeded. This is also supported by the consistent sampling of non-detects approximately one year after the cycloxydim application. In total, 52 of 195 samples contained E/Z BH 517-TSO, one in a concentration  $> 0.1 \mu\text{g/L}$  in a drainage sample. BH 517-T2SO<sub>2</sub> was detected neither in a total of 49 drainage samples nor 146 groundwater samples from September 2018 to October 2020, when the monitoring ended.

### **Florasulam**

Florasulam was tested in two different crops, winter wheat at Estrup and Silstrup, and winter barley at Lund from July 2020 to June 2022. None of the four included degradation products (5-OH-florasulam, DFP-ASTCA, DFP-TSA, and TSA) were detected in groundwater at Silstrup, Estrup, and Lund (at which only TSA was monitored). However, TSA and 5-OH-florasulam were detected in drainage at Silstrup and Estrup, respectively, and only 5-OH-florasulam was detected in a concentration  $> 0.1 \mu\text{g/L}$ . This detection was in a drainage sample from Estrup approximately two months after the florasulam application in May 2020. DFP-ASTCA and DFP-TSA were not detected. During the monitoring of TSA at Lund from May 2018 to March 2021, there were no detections of TSA (florasulam was also applied in 2018). Monitoring of the four degradation products, 5OH-florasulam, DFP-ASTCA, DFP-TSA, and TSA at Silstrup and Estrup ended in March 2022 after two years of monitoring.

### **Fluopyram**

Fluopyram was tested in three different crops, rapeseed at Faardrup, spring barley at Jyndeved, Silstrup, and Lund, and winter wheat at Silstrup, Faardrup, and Lund during the monitoring period May/June 2021 - June 2022. At Silstrup, fluopyram and the degradation product fluopyram-7-hydroxy are both detected in drainage following the application of fluopyram in spring barley in June 2021. Only fluopyram was detected in a concentration  $> 0.1 \mu\text{g/L}$  ( $0.21 \mu\text{g/L}$ ) in a drainage sample approximately one month after the application. In groundwater monitoring wells downstream of the field, only fluopyram is detected at two sampling events, October 2021, and March 2022, both in concentrations  $< 0.1 \mu\text{g/L}$ . At Lund, fluopyram was detected twice (December 2021 and February 2022) and only in drainage in concentrations  $< 0.1 \mu\text{g/L}$  after the fluopyram application in winter wheat in June 2021. Fluopyram was not detected in groundwater or drainage/water from suction cups at Jyndeved and Faardrup, and fluopyram-7-hydroxy was likewise neither detected in groundwater nor drainage/water from suction cups at Jyndeved, Faardrup, and Lund. The monitoring period following the fluopyram applications in June 2022 at all four fields, is too short for a thorough evaluation and is regarded as preliminary. Monitoring of fluopyram and fluopyram-7-hydroxy is ongoing in all fields.

### **Halauxifen-methyl**

Halauxifen-methyl was tested in May 2019 in spring barley at Estrup, and winter barley and winter rapeseed at Lund. The degradation product, X-729 was included in the monitoring and not detected in drainage or groundwater, neither in the period before the halauxifen-methyl applications (May 2019) nor in the monitoring period after application. The monitoring ended in March 2021 at both Estrup and Lund. In conclusion, X-729 did not give rise to groundwater detections above the limit value during the monitoring period.

It is noted that the bromide tracer test done at Lund in 2017, seemed to have been erroneous. Consequently, the hydraulic connectivity of the screens and the groundwater is yet unclear. This might affect the interpretation of the test, as the lack of X-729 detections can be a consequence of lacking hydraulic connectivity (refer to Chapter 5.5). However, as X-729 is not detected in drainage during the monitoring period, the compound is not expected to leach into the groundwater. The water dynamics at Lund are presently under evaluation and a new bromide tracer experiment will be conducted in January 2023.

### **Picloram**

Picloram was tested in winter rapeseed at Lund in December 2019 and was not detected in water from drainage and groundwater before the picloram application. Picloram was after the application detected once in a drainage sample ( $0.011 \mu\text{g/L}$ ) approximately one month after application, and once in groundwater from the upstream well M1 in May 2021 ( $0.053 \mu\text{g/L}$ ). Picloram was included in the monitoring in November 2019 and the monitoring ended in December 2021.

As the bromide tracer test done at Lund in 2017, seemed to have been erroneous, the hydraulic connectivity of the screens and the groundwater is yet unclear. It is therefore not known if the upstream well M1 is in hydraulic contact with water percolating from the field or not. This also affects the interpretation of the downstream wells, where the lack of picloram detections might be a consequence of lacking hydraulic connectivity (refer to Chapter 5.5). Hence data should be interpreted as preliminary and picloram is listed for retesting, when possible, according to crop rotation. The water dynamics at Lund are presently under evaluation and a new bromide tracer experiment will be conducted in January 2023.

### **Propaquizafop**

Propaquizafop was tested in winter rapeseed at Silstrup in 2019-2021. Four propaquizafop degradation products, CGA 287422, CGA 290291, CGA 294972, and PPA were included in the monitoring. None of the degradation products were detected in water from drainage or groundwater, neither before nor after application to December 2021 when the monitoring ended. In conclusion, the four propaquizafop degradation products, CGA 287422, CGA 294972, CGA 290291, and PPA did not give rise to groundwater detections above the limit value during a two-year monitoring period at the clay till field Silstrup.

### **Propyzamide**

Propyzamide was tested in winter rapeseed at Silstrup from October 2018 to February 2021 and at Lund from October 2019 to September 2021. At Faardrup the test was initiated in October 2020 and is still ongoing. Propyzamide was detected in drainage in concentrations  $> 0.1 \mu\text{g/L}$  at all three fields. At Silstrup, propyzamide was detected during the first drainage event after propyzamide application. This was five days after application and propyzamide was detected in a concentration of  $5.1 \mu\text{g/L}$ . A similar trend was observed at Faardrup where propyzamide was detected in a high concentration ( $7.0 \mu\text{g/L}$ ) at the first drainage event after propyzamide application (two months after application). Propyzamide was also detected in drainage shortly after application at Lund; the first detection of propyzamide was three days after application ( $0.13 \mu\text{g/L}$ ), whereas the maximum concentration ( $0.41 \mu\text{g/L}$ ) was detected approximately one month later. The two degradation products, RH-24644 and RH-24580, were both included in the monitoring at Lund. Only RH-24644 was detected in drainage and it was detected twice concomitantly with the detections of propyzamide immediately after the propyzamide application. One of these detections was in a concentration  $> 0.1 \mu\text{g/L}$  ( $0.11 \mu\text{g/L}$ ).

Propyzamide was detected in groundwater from all three fields, but only at Silstrup in a concentration  $> 0.1 \mu\text{g/L}$ . The leaching of propyzamide is generally observed with the first drainage event after application. Also, detections of propyzamide in groundwater coincided with detections in drainage at all three fields, although the concentration magnitude was lower.

In conclusion, propyzamide leaching was found to both drainage within the first drainage event after the propyzamide application, and to groundwater at the three clay till fields included in the test, Silstrup, Faardrup, and Lund. Detections of concentrations  $> 0.1 \mu\text{g/L}$  occurred in drainage at all fields but decreased rapidly, while the limit value was only exceeded in groundwater at Silstrup approximately three months after application after which no more detections were made.

### **Proquinazid**

Proquinazid was tested in 2019 in two different crops; winter rye at Jyndeved and spring barley at Faardrup. Two proquinazid degradation products, IN-MM671 and IN-MM991 were included in the monitoring. None of these were detected in water from the suction cups, drainage, groundwater, or irrigation water, neither in the period before the proquinazid applications (April/June 2019) nor during the monitoring period from April/June 2019 to March 2021, where the monitoring ended at both fields. In conclusion, the two proquinazid degradation products, IN-MM671 and IN-MM991 did not give rise to groundwater detections above the limit value during a two-year monitoring period at the sandy field Jyndeved and clay till field Faardrup.

### **Pyroxsulam**

Pyroxsulam was tested in winter wheat at both Silstrup and Estrup from April/May 2020 to March 2022. None of the five included degradation products, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide were detected in groundwater at neither Silstrup nor Estrup. However, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and PSA were detected in drainage at Estrup, but only PSA was detected in concentrations > 0.1 µg/L (max. concentration 0.25 µg/L). These PSA detections were in two drainage samples approximately two months after the pyroxsulam application in May 2020. 6-Cl-7-OH-pyroxsulam and pyridine sulfonamide were not detected in drainage at any of the fields. In conclusion, the monitoring of 5-OH-pyroxsulam, 6-Cl-7-OH-pyroxsulam, 7-OH-pyroxsulam, PSA, and pyridine sulfonamide from the pyroxsulam tests showed that these degradation products did not leach to the groundwater. Although detected in a few drainage samples, the monitored degradation products seemed to be removed (e.g. further transformed or sorbed) before reaching the groundwater. Monitoring of the five degradation products, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide at Silstrup and Estrup ended in March 2022 after two years of monitoring.

### **Thifensulfuron-methyl**

During 2021-2022, thifensulfuron-methyl was tested in two different crops, spring barley, and perennial ryegrass at Estrup, and three degradation products, IN-B5528, IN-JZ789, and IN-L9223 were included in the monitoring. None of the degradation products were detected in water from drainage or groundwater, neither in the period before the thifensulfuron-methyl application (April-June 2021) nor in the monitoring period from June 2021 to June 30, 2022. In conclusion, IN-B5528, IN-JZ789, and IN-L9223 did not give rise to groundwater detections above the limit value during the present monitoring period. However, the monitoring is ongoing, and a final evaluation will be presented in the following PLAP report.

### **Thiophanate-methyl**

Thiophanate-methyl was tested in winter wheat at Jynde vad and Estrup in 2018. The degradation product, carbendazim was detected in three drainage samples at Estrup in concentrations < 0.1 µg/L. The compound was not detected in any other samples collected from the suction cups, drainage, groundwater, or irrigation water, neither in the period before the thiophanate-methyl applications (May 2018) nor in the monitoring period from June 2018 to the end of monitoring in October 2020 at Jynde vad and Estrup.

### **Tribenuron-methyl**

Tribenuron-methyl was in 2022 tested in two different crops, spring barley at Jynde vad and Lund, and winter wheat at Silstrup and Faardrup. Three degradation products, IN-B5528, IN-R9805, and M2 were included in the monitoring. None of these were detected in water from the suction cups, drainage, groundwater, or irrigation water, neither in the period before the tribenuron-methyl application (April/May 2022) nor in the monitoring period from April/May 2022 to June 30, 2022. However, the monitoring period after the tribenuron-methyl applications in April/May 2022, at all four fields, to the end of the reporting period on June 30, 2022, was too short for a thorough evaluation and data should be interpreted as preliminary. Monitoring of the three degradation products, IN-B5528, IN-R9805, and M2 is ongoing at all four fields, Jynde vad, Silstrup, Faardrup, and Lund.

## 1. Introduction

In Denmark, nearly all drinking water is based on groundwater that undergoes a simple treatment, where the water is aerated and passed through a filter of sand. As Denmark is intensively cultivated, there is public concern about pesticides and their degradation products being increasingly detected in groundwater during the past decades. Since 1989, this concern was the basis for initiating monitoring programmes reporting on the quality of the Danish groundwater (the Danish National Groundwater Monitoring Programme; GRUMO; Thorling *et al.*, 2023) and the effect of agricultural practices (the Pesticide Leaching Assessment Programme, PLAP). The reported results have been and are still continuously addressed in the regulation of pesticides.

The detection of pesticides in groundwater since the 1980s has demonstrated the need for further enhancement of the scientific foundation for the existing approval procedure for pesticides and to improve the present leaching risk assessment tools. The main issue in this respect is that the EU groundwater risk assessment, and hence also the Danish assessment of the risk of pesticides and/or their degradation products leaching to groundwater, is largely based on modelling studies and, if available, lysimeter studies (Gimsing *et al.*, 2019). However, those types of data may not adequately describe the leaching which may occur under actual field conditions. Although models are widely used within the registration process, their validation requires further work (Gassmann, 2021). The FOCUS models (FORum for Co-ordination of pesticide fate models and their Use) applied in the EU process are one-dimensional and at the lowest tier, use climate standards from 1960-1990, apply constant groundwater table at 2 m depth, and have limited inclusion of preferential solute transport added with issues regarding parameter and input estimation caused by the lack of field data (Boesten, 2000; Rosenbom *et al.*, 2015). Moreover, laboratory and lysimeter studies only to a minor degree include the spatial variability of the soil parameters (hydraulic, chemical, physical, and microbiological soil properties) affecting the pesticide transformation and coherent assessed leaching of the degradation products (Gassmann, 2021). This is of particular importance for silty and clay till soils, where preferential transport may have a major impact on pesticide leaching (Jacobsen and Kjær, 2007; Rosenbom *et al.*, 2015). Various field studies suggest that considerable preferential transport of several pesticides occurs to a depth of 1 m under conditions comparable to those present in Denmark (Kördel, 1997; Jarvis, 2020).

The inclusion of field studies, i.e., test plots exceeding one hectare, in risk assessment of pesticide leaching to groundwater is considered an important improvement to the assessment procedures. For example, the US Environmental Protection Agency (US EPA) has since 1987 included field-scale studies in its risk assessments (US EPA, 1998). Therefore, pesticides that may potentially leach into the groundwater are required to be included in field studies as part of the registration procedure, and the US EPA conducted field studies with more than 50 pesticides in the period 1987-1998. A similar concept was hereafter adopted by the European Union (EU), where Directive 91/414/EEC, Annexe VI (Council Directive 97/57/EC of 22 September 1997) came into force enabling field leaching study results to be included in the risk assessments. This was enforced in 2011 by supplementing Regulation (EC) 1107/2009 with the uniform principles in Regulation 546/2011 (Annex C 2.5.1.2) (European Commission, 2011) allowing simulated groundwater concentrations above the guideline to be discarded if “it is scientifically demonstrated that under relevant field conditions the lower concentration is not exceeded” (Gimsing *et al.*, 2019).

### 1.1 Objective

In 1998, the Danish Government initiated the Pesticide Leaching Assessment Programme (PLAP), which is an intensive monitoring programme to evaluate the leaching risk of pesticides under field conditions. The PLAP is intended to serve as an early warning system providing decision-makers with advance warning if otherwise approved pesticides or their selected degradation products leach in unacceptable concentrations. The

programme, which currently includes five active agricultural fields and one field on stand-by, focuses on pesticides used in arable farming and monitors leaching through the agricultural fields (Figure 1.1). All six fields are selected to represent typical Danish geological settings and climatic conditions. Except for one (Lund), all the fields were included in the monitoring since 1999. To increase the representability, the field at Lund (clay till overlaying chalk), was included in May 2017 based on a one-time special grant from the Danish EPA. Subsequently, at the end of 2018, monitoring at Lund was continued, while the sandy field (Tylstrup) was put on stand-by, because of the termination of the special grant.

The objective of PLAP is to improve the scientific foundation for decision-making in the Danish registration and approval procedures for pesticides by enabling field studies to be included in the risk assessment of selected pesticides. The specific aim is to evaluate whether approved pesticides applied in accordance with current regulations and maximum permitted dosages according to crop and BBCH stages, under actual, Danish field conditions can result in leaching of the pesticides and/or their degradation products to the groundwater in concentrations exceeding the limit value of 0.1 µg/L for groundwater and drinking water.

## 1.2 Structure of PLAP

The pesticides included in PLAP are selected based on expert judgement by the Danish EPA. At present, 53 pesticides and 105 degradation products have been included in PLAP. All compounds (pesticides and degradation products) analysed since 1999 are listed in Appendix 1.

Soil type and climatic conditions are considered some of the most important parameters controlling pesticide leaching (e.g., Flury, 1996). Today, PLAP encompasses six fields that represent dominant soil types and climatic conditions in Denmark (Figure 1.1). The sandy field Tylstrup was set on stand-by at the end of 2018, and consequently, no water samples are collected for analysis from this field. The groundwater table at the PLAP fields is relatively shallow (generally fluctuating between 1 and 5 meters below ground surface (mbgs)), enabling rapid detection of pesticide leaching to groundwater. Cultivation of the PLAP fields is done in accordance with the conventional agricultural practice in the local area. The pesticides are applied at maximum permitted dosages as specified in the regulations. Thus, any pesticides or degradation products appearing in the groundwater downstream of the fields can, with a few exceptions (e.g., the azoles) be related to the current approval conditions and use of the given pesticide.

Results and data in the present report comprise the six fields Tylstrup (data only in Chapter 8 and Appendix 3), Jyndevad, Silstrup, Estrup, Faardrup, and Lund. The location of the fields is shown in Figure 1.2.1 with more detailed characteristics given in Table 1.2.1 and Chapter 2.

Field characterization and monitoring design are described in detail by Lindhardt *et al.* (2001) for the five fields Tylstrup, Jyndevad, Silstrup, Estrup, and Faardrup, and in Haarder *et al.* (2021) for Lund. The focus of the current report is on the leaching risk of pesticides and/or degradation products included in the July 2020-June 2022 monitoring. Chapter 8 gives an overview of results from the entire monitoring period May 1999-June 2022 at all six fields. Detailed descriptions of the earlier monitoring periods from May 1999 to June 2020 are published in previous reports, available at [www.plap.dk](http://www.plap.dk). Within PLAP, the leaching risk of pesticides and degradation products is based on approximately two years of monitoring data.

For pesticides applied in April-June 2022, the present reporting must be considered preliminary, as these compounds have only been monitored for a short period. Thus, monitoring results for these compounds will be further evaluated in the coming reports.

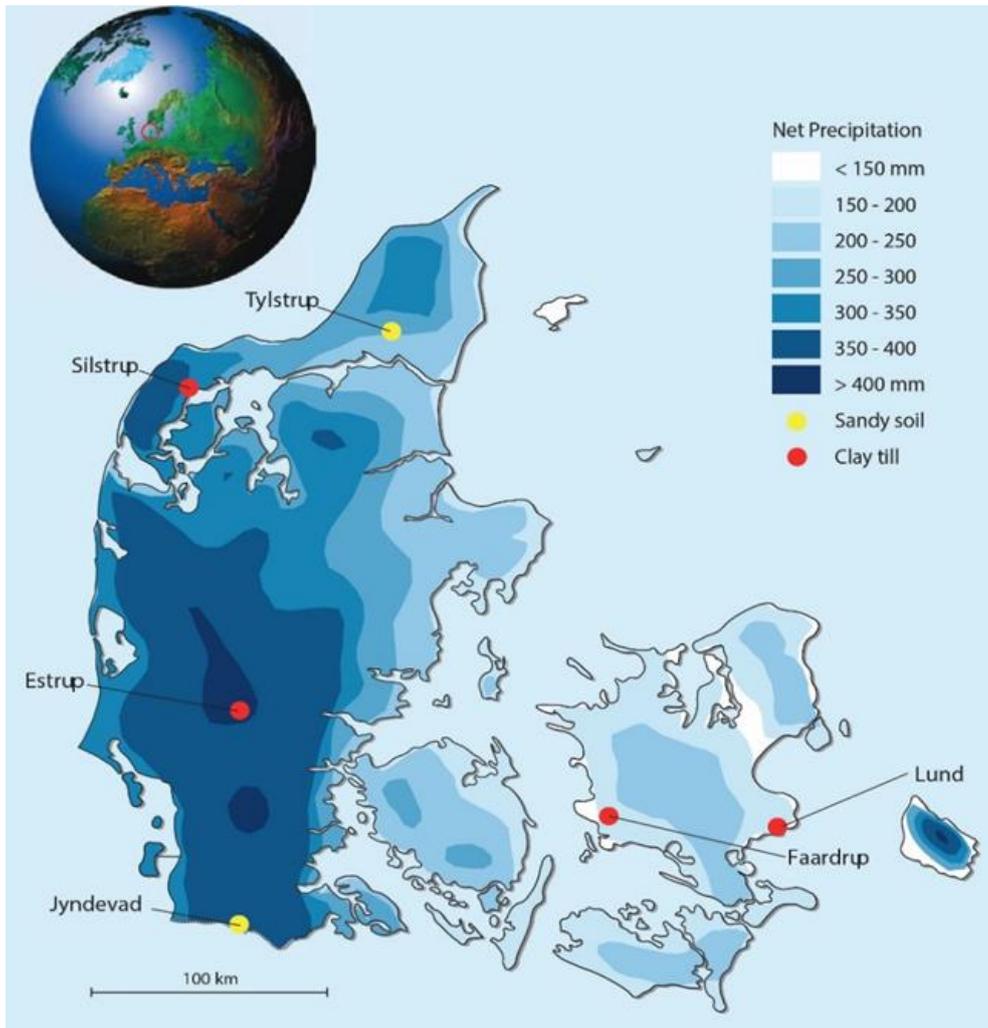


Figure 1.2.1. Annual net precipitation across Denmark (Danish EPA, 1992) and location of the six PLAP fields: Tylstrup (sandy, on stand-by), Jydevad (sandy), Silstrup (clay till), Estrup (clay till), Faardrup (clay till), and Lund (clay till).

To support the pesticide analysis results, hydrological modelling of the variably saturated zone was conducted with MACRO (version 5.2, Larsbo *et al.*, 2005) to describe and evaluate the soil water dynamics of the six PLAP fields. Models for the five fields Tylstrup, Jydevad, Silstrup, Estrup, and Faardrup were calibrated for the monitoring period May 1999–June 2004 and applied for the monitoring period May 1999–June 2022. For Lund, the model is preliminary and manually calibrated for March 2018–June 2020.

All six fields are fertilized in accordance with agricultural practices and water samples collected within the monitoring period are additionally analysed for inorganic compounds. All fields, except Lund, were subjected to at least three bromide applications, and bromide analyses were included in the inorganic analyses. The bromide measurements are used to obtain knowledge about flow and transport pathways in the subsurface beneath the fields and support the hydrological modelling. A second bromide application in Lund will be done in January 2023.

Table 1.2.1. Characteristics of the six PLAP fields included in the PLAP-monitoring for the period 1999–2022 (modified from Lindhardt et al., 2001). Tylstrup was set on standby by the end of December 2018.

	<b>Tylstrup on stand-by</b>	<b>Jyndeved</b>	<b>Silstrup</b>	<b>Estrup</b>	<b>Faardrup</b>	<b>Lund</b>
Location	Brønderslev	Tinglev	Thisted	Askov	Slagelse	Rødvig
Precipitation <sup>1)</sup> (mm/y)	752	995	976	968	626	577 <sup>4)</sup>
Pot. evapotransp. <sup>1)</sup> (mm/y)	553	554	564	543	586	568 <sup>4)</sup>
Width (m) x Length (m)	70 x 166	135 x 180	91 x 185	105 x 120	150 x 160	100 x 300
Area (ha)	1.2	2.4	1.7	1.3	2.3	2.8
Tile drain	No	No	Yes	Yes	Yes	Yes
Depths to tile drain (m)			1.1	1.1	1.2	1.1
Monitoring initiated	May 1999	Sep 1999	Apr 2000	Apr 2000	Sep 1999	July 2017
<b>Geological characteristics</b>						
– Deposited by	Saltwater	Meltwater	Glacier	Glacier /meltwater	Glacier	Glacier
– Sediment type	Fine Sand	Coarse Sand	Clayey till	Clayey till	Clayey till	Clayey till
– DGU symbol	YS	TS	ML	ML	ML	ML
– Depth to the calcareous matrix (m)	6	5–9	1.3	1–4 <sup>2)</sup>	1.5	1.5
– Depth to the reduced matrix (m)	>12	10–12	5	>5 <sup>2)</sup>	4.2	3.8
– Max. fracture depth <sup>3)</sup> (m)	–	–	4	>6.5	8	>6
– Fracture intensity 3–4 m depth (fractures m <sup>-1</sup> )	–	–	<1	11	4	<1
– Saturated hydraulic conductivity (Ks) in C horizon (m/s)	2.0·10 <sup>-5</sup>	1.3·10 <sup>-4</sup>	3.4·10 <sup>-6</sup>	8.0·10 <sup>-8</sup>	7.2·10 <sup>-6</sup>	5.8·10 <sup>-6</sup>
<b>Characteristics of the plough layer</b>						
– DK classification	JB2	JB1	JB7	JB5/6	JB5/6	JB5/6
– Classification	Loamy Sand	Sand	Sandy clay loam / sandy loam	Sandy loam	Sandy loam	Sandy loam
– Clay content (%)	6	5	18–26	10–20	14–15	10–25
– Silt content (%)	13	4	27	20–27	25	30–35
– Sand content (%)	78	88	8	50–65	57	30–50
– pH	4–4.5	5.6–6.2	6.7–7	6.5–7.8	6.4–6.6	7.4–9.1
– Total organic carbon (TOC, %)	2.0	1.8	2.2	1.7–7.3	1.4	0–1.3

<sup>1)</sup> Normal values based on time series for 1961–1990. Precipitation values are corrected to the soil surface (Olesen, 1991). <sup>2)</sup> Large variation within the field. <sup>3)</sup> Maximum fracture depth refers to the maximum fracture depth found in excavations and wells. <sup>4)</sup> Normal values based on time series for 1961–1990. Precipitation values are corrected to the soil surface (Scharling, 2000).

Scientifically valid analytical methods are essential to ensure the integrity of PLAP, and thus all chemical analyses of pesticides and degradation products are conducted by an accredited commercial laboratory. The field monitoring work is additionally supported by quality assurance entailing continuous evaluation of the analytical methods employed. Here, it is noted that several compounds that should have been introduced in the analytical programme in May 2018, April 2019, and April 2020 were not introduced as planned. This was due to a delay in internal procedures regarding the selection of compounds for the monitoring programme in these periods, and thus delays in both the procurement of the analytical standards and consequently analytical method development. Therefore, samples collected from May 2018 and onward and from April 2019 and 2020 and onward for analysis of 25 compounds were stored at -20°C for 0.5–11 months until the analytical methods were ready for sample analysis (Table 7.3.1 and the previous report, Badawi et al. 2022). As the stability of these compounds, when frozen for several months, is currently unknown, results from these periods should be considered tentative. Work is presently ongoing to evaluate the stability of these

compounds at -20°C. The quality assurance methodology and results are presented in Chapter 7 and Appendix 6.

In the previous report (Badawi *et al.*, 2022), data from all the bromide applications in the fields were revisited and analysed for the first time in conjunction. The analyses aimed to gain further knowledge of transport times and improve the fundamental understanding of hydrogeology in the fields. In the present report, the bromide evaluations from the previous report are included for convenience in Chapter 5.

## 2. Field descriptions and monitoring design

The six PLAP fields have an overall similar design (Figure 2.1.1-2.6.1). Each field consists of a cultivated area surrounded by an uncultivated buffer zone with grass cover. Groundwater samples are collected from vertical and horizontal monitoring wells, whereas water samples from the variably saturated zone 1 mbgs are collected through suction cups installed at the edge of the cultivated area. At the tile-drained clayey fields, water samples are collected from the drainage system, which is placed at a depth of approximately 1 mbgs, thus, also representing the variably saturated zone. The drainage system underneath the PLAP field has been disconnected from the drainage pipes of the surrounding fields, such that only drainage water stemming from the PLAP field itself is collected at the drainage outlet. The piezometer wells (marked "P") are generally placed along the outer border of the field in the buffer zone and are used for assessing the general flow direction underneath the field through measurements (both manually and automated) of the level of the groundwater table.

Monitoring wells (marked "M"), from which water samples are obtained, are placed in accordance with the general groundwater flow direction such that several monitoring wells are placed in the buffer zone downstream of the field as well. That is downstream of the general groundwater flow direction. Similarly, a well is located upstream of the field, i.e., upstream of the general groundwater flow direction. Hence, the upstream well is assumed not to represent water from the monitoring field and thereby not influenced by compound application on the PLAP field. The naming of screens in the monitoring wells follows these principles: The upper-most screen "Mx.1" is commonly placed at a depth of around 2 mbgs, and the following screens "Mx.2", "Mx.3" and "Mx.4" are commonly placed at depth of around 3 m, 4 m, and 5 m, respectively. Horizontal monitoring wells are installed on five of the six PLAP fields. These wells consist of three horizontal screens from which water can be sampled. The horizontal wells installed in 2008 at the clay till fields (H1 and H2 at Silstrup and Faardrup, and H1 at Estrup) are placed at a depth of 3.5 mbgs, whereas the newer horizontal wells installed in 2011 are located at 2.5 mbgs (H1 at Jyndevad) and 2 mbgs (H3 at Silstrup and Faardrup, and H2 at Estrup). In the tile-drained fields, it was attempted to position the horizontal wells such that one of the three well screen segments was placed directly underneath a portion of the tile-drain.

Each PLAP field is further equipped with sensors for measuring soil moisture content and soil temperature to a depth of 2.1 m. Climate data such as precipitation, air temperature, barometric pressure, global radiation, and wind speed for each PLAP field are also collected locally.

Since the initiation of PLAP, different wells and screens were sampled during different periods. In the early years, several samples were taken at each sampling campaign, but due to later budget reductions, it was decided to sample only the two uppermost well screens below the groundwater table in the vertical monitoring wells with the notion to sample the shallow groundwater. Additionally, only approximately 3 monitoring wells at each field were sampled monthly, with further 2-3 wells sampled half-yearly. Samples from the horizontal wells and suction cups at 1 mbgs were collected monthly. When the groundwater table was below the depth of the horizontal screens, however, it was not possible to obtain samples. Drainage samples were collected every week during drainage occurrence. Note that Appendix 2 describes the sampling procedure in more detail.

## 2.1 Jyndeavad

Jyndeavad is located in southern Jutland (Figure 1.2.1). The field covers a cultivated area of 2.4 ha (135 x 180 m) and is practically flat. A windbreak borders the eastern side of the field, which is otherwise surrounded by conventionally cultivated agricultural fields. The area has a shallow groundwater table ranging from 1 to 3 mbgs (Figure 4.1.1B). The overall direction of groundwater flow is towards the northwest (Figure 2.1.1). The soil is classified as Arenic Eutrudept and Humic Psammentic Dystrudept (Soil Survey Staff, 1999) with coarse sand as the dominant texture class and topsoil containing 5% clay and 1.8% total organic carbon (Table 1.2.1). The geological description points to Jyndeavad being located on a sandy meltwater plain, with local occurrences of thin clay and silt beds.

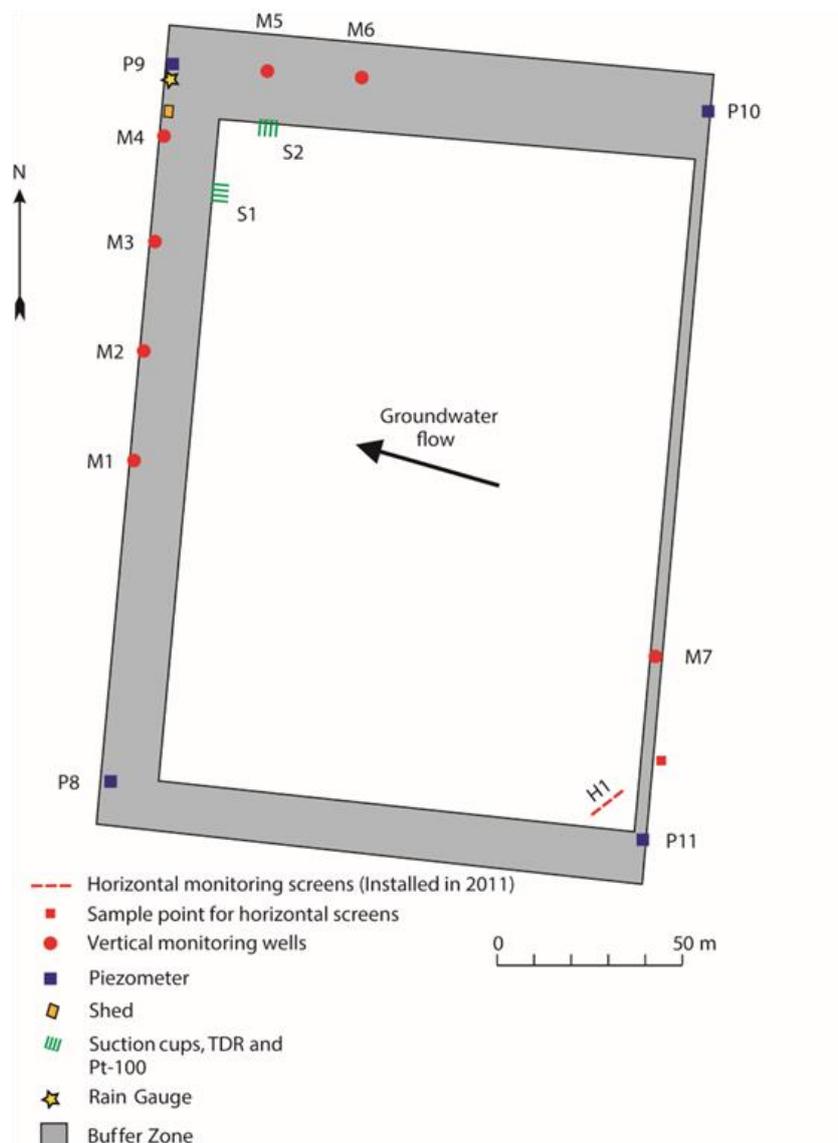


Figure 2.1.1. Overview of the Jyndeavad field. The innermost white area indicates the cultivated area surrounded by the buffer zone. Pesticide monitoring is conducted monthly and half-yearly from selected horizontal and vertical monitoring screens and suction cups as described in section 2.1 and Appendix 2. At S1 and S2, water content (via TDR) and soil temperature (via Pt100) is measured at four different depths. Additionally, suction cups are installed to collect pore water from the variably saturated matrix for analysis of pH-independent compounds.

In September 2011, the monitoring system was extended with three horizontal screens (H1) 2.5 mbgs in the southeastern corner of the field (Figure 2.1.1). A brief description of the drilling and design of H1 is given in Appendix 8.

The water sampling plan has been altered several times since the beginning of PLAP. During the current monitoring period, water sampling for pesticide analysis at Jyndevad was done monthly from suction cups at 1 m depth at S1 and S2 and wells M1, M4, M7, and H1. Additional samples from wells M2 and M5 were collected 4 times per year. No sampling was done from suction cups at 2 m depth at S1 and S2 and wells M3 and M6. For several months during the summer and fall it was not possible to obtain water samples from the horizontal well H1 as the groundwater table was below screen depth. Appendix 2 describes the sampling procedure in more detail.

## 2.2 Silstrup

The test field at Silstrup is located south of the city Thisted in northwestern Jutland (Figure 1.2.1). The cultivated area is 1.7 ha (91 x 185 m) and slopes gently 1–2° to the north (Figure 2.2.1). Based on two profiles excavated in the buffer zone bordering the field, the soil was classified as Alfic Argiudoll and Typic Hapludoll (Soil Survey Staff, 1999). The clay content in the topsoil was 18% and 26%, and the organic carbon content was 3.4% and 2.8%, respectively (Table 1.2.1). The geological description showed a rather homogeneous clay till rich in chalk and chert, containing 20–35% clay, 20–40% silt, and 20–40% sand. In some intervals the till was sandier, containing only 12–14% clay. Moreover, thin lenses of silt and sand were detected in some of the wells. The gravel content was approximately 5% but could be as high as 20%.

In September 2011, the monitoring system was extended with three horizontal screens (H3) 2 mbgs in the north-eastern corner of the field (Figure 2.2.1). One of the screens is expected to be located directly below a segment of the tile drain 1.1 mbgs, whereas the other two screens should be located between two tile drains. A brief description of the drilling and design of H3 is given in Appendix 8.

The water sampling plan has been revised several times since the beginning of PLAP. During the current monitoring period, water sampling at Silstrup was done monthly from wells M5, M9, H1.2, and H3; with additional samples collected three to four times per year from wells M10 and M12. No sampling is done from wells M1-4, M6-8, M11, M13, and H2. Appendix 2 describes the sampling procedure in more detail.

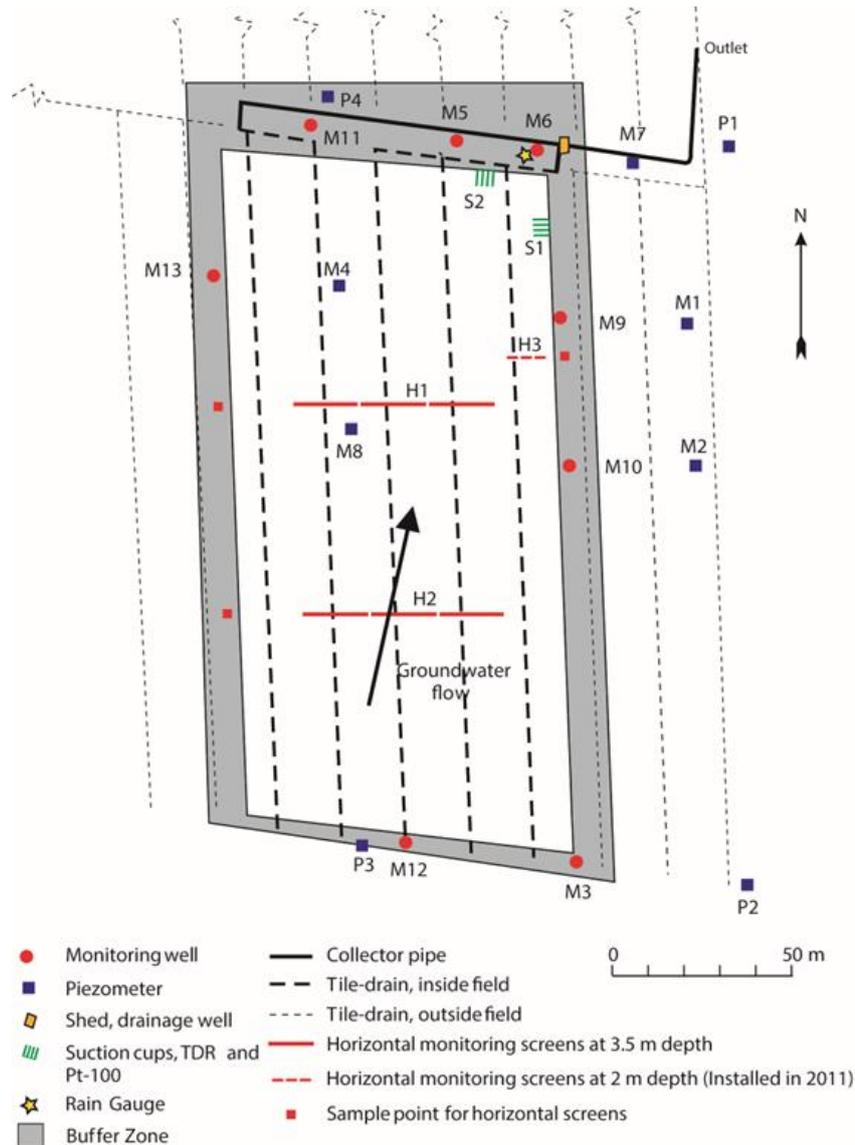


Figure 2.2.1. Overview of the Silstrup field. The innermost white area indicates the cultivated area surrounded by the buffer zone. Pesticide monitoring is conducted weekly from the tile drain system from a drainage well (during periods of continuous drainage) and monthly and half-yearly from selected vertical and horizontal monitoring screens as described in section 2.2 and Appendix 2. At S1 and S2, water content (via TDR) and soil temperature (via Pt100) is measured at four different depths. Additionally, suction cups are installed to collect pore water from the variably saturated matrix for analysis of pH-independent compounds.

### 2.3 Estrup

Estrup is located in central Jutland (Figure 1.2.1) west of the Main Stationary Line on a hill-island, i.e. a glacial till preserved from the Saalian Glaciation. Estrup has thus been exposed to weathering, erosion, leaching, and other geomorphological processes for a much longer period than the other fields (approximately 140,000 years). The test field covers a cultivated area of 1.3 ha (105 x 120 m) and is nearly flat (Figure 2.3.1). The field is highly heterogeneous with considerable variation in both topsoil and aquifer characteristics (Lindhardt *et al.*, 2001), which is quite common for this geological formation. Based on three profiles excavated in the buffer zone bordering the field the soil was classified as Abrupt Argiudoll, Aqua Argiudoll, and Fragiaquic Glossudalf (Soil Survey Staff, 1999). The topsoil is characterised as sandy loam with a clay content of 10–20% and organic carbon content of 1.7–7.3%. A C-horizon of low permeability also characterises the field. The

saturated hydraulic conductivity in the C-horizon is  $10^{-8}$  m/s, which is about two orders of magnitude lower than at the other clay till fields (Table 1.2.1). The geological structure is complex comprising a clayey till core with deposits of different ages and compositions including freshwater peat in the southwestern part of the field (Lindhardt *et al.*, 2001).

In September 2011, the monitoring system was extended with three horizontal screens (H2) 2 mbgs in the north-eastern part of the field (Figure 2.3.1). One of the screens is expected to be located directly below a segment of the tile drain 1.1 mbgs, whereas the other two screens should be located between two tile drains. A brief description of the drilling and design of H2 is given in Appendix 8.

The water sampling plan has been revised several times since the beginning of PLAP. During the current monitoring period, water sampling at Estrup was done monthly from wells M4, H1.2, and H2 (and from M6 until January 1, 2019), with additional samples collected three to four times per year from wells M1, M5, and M6. No sampling is done from wells M2, M3, and M7.

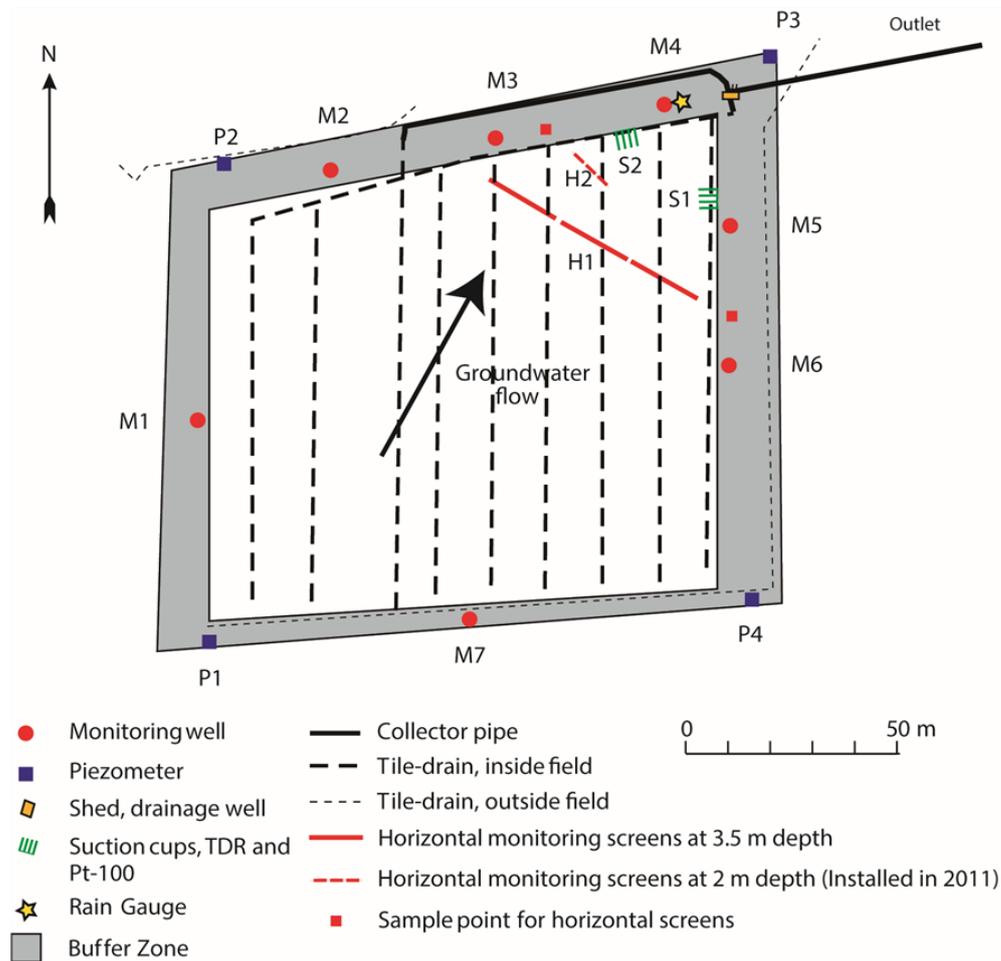


Figure 2.3.1. Overview of the Estrup field. The innermost white area indicates the cultivated area surrounded by the buffer zone. Pesticide monitoring is conducted weekly from the tile drain system in a drainage well (during periods of continuous drainage) and monthly and half-yearly from selected vertical and horizontal monitoring screens as described in section 2.3 and Appendix 2. At S1, water content (via TDR) and soil temperature (via Pt100) are measured at four different depths. Additionally, suction cups are installed at both S1 and S2 to collect pore water from the variably saturated matrix for analysis of pH-independent compounds.

## 2.4 Faardrup

Faardrup is located in southern Zealand (Figure 1.2.1) and the test field covers a cultivated area of 2.3 ha (150 x 160 m, Figure 2.4.1). The terrain slopes gently (1–3° to the west). Based on three soil profiles excavated in the buffer zone bordering the field, the soil was classified as Haplic Vermudoll, Oxyaquic Hapludoll, and Oxyaquic Argiudoll (Soil Survey Staff, 1999). The topsoil is characterised as sandy loam with 14–15 % clay and 1.4 % organic carbon. Within the upper 1.5 m, numerous desiccation cracks coated with clay are present. The test field contains glacial deposits dominated by sandy till to a depth of about 1.5 m overlying a clay till. The geological description shows that small channels or basins filled with meltwater clay and sand occur both interbedded in the till and as a large structure crossing the test field (Lindhardt *et al.*, 2001). The calcareous matrix and the reduced matrix begin at 1.5 m and 4.2 mbgs, respectively.

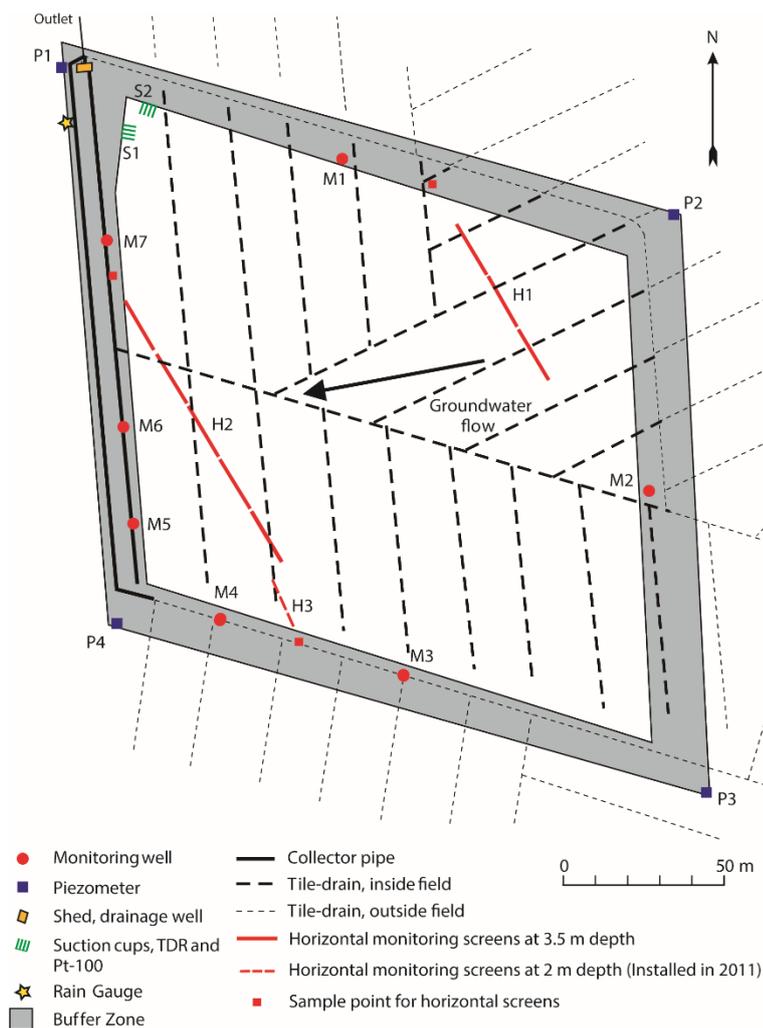


Figure 2.4.1. Overview of the Faardrup field. The innermost white area indicates the cultivated area, while the grey area indicates the surrounding buffer zone. The positions of the various installations are indicated, as is the direction of groundwater flow (arrow). Pesticide monitoring is conducted weekly from the tile drain system via a drainage well underneath the shed (during periods of continuous drainage), and monthly and half-yearly from selected vertical and horizontal monitoring screens as described in section 2.4 and Appendix 2. At S1 and S2, water content (via TDR) and soil temperature (via Pt100) is measured at four different depths as at the other PLAP fields. Additionally, suction cups are installed to collect pore water from the variably saturated matrix for analysis of pH-independent compounds.

The dominant direction of groundwater flow is towards the west in the upper part of the aquifer (Figure 2.4.1). During the whole monitoring period of 1999-2022, the groundwater table was located at 1-3 mbgs. During fieldwork within a 5 m deep test pit dug nearby the field, it was observed that most of the water entering the pit came from an intensely horizontally-fractured zone in the till at a depth of 1.8–2.5 m. The intensely fractured zone could very well be hydraulically connected to the sand fill in the deep channel, which might facilitate parts of the percolation.

In September 2011, the monitoring system at Faardrup was extended with three horizontal screens (H3) 2 mbgs in the southwestern corner of the field (Figure 2.4.1). A brief description of the drilling and design of H3 is given in Appendix 8.

The water sampling plan was revised several times since the beginning of PLAP. During the current monitoring period, water sampling at Faardrup is done monthly from wells M4, M5, H2, and H3, and half-yearly from well M6 and M2. No sampling was done from wells M1, M3, M7, and H1. Note that there was no water in the screens at H3 during most of the period as the groundwater table was below screen depth, i.e., it was not possible to collect all planned samples. Appendix 2 describes the sampling procedure in more detail.

## 2.5 Lund

Lund is located in the southern part of the Stevns peninsula in the eastern part of Zealand 500 m west of the village Lund (Figure 1.2.1). The entire area is a glacial till plain formed during the Weichselian glaciation, and the topographic map shows that mega-lineations are trending southeast-northwest across the landscape. These are formed subglacially and indicate the ice movement direction (Houmark-Nielsen, 2011). The soil types in the area are classified as clay till overlying bryozoan limestone of the Danien age. The field is located south of the road Lundeledsvej, approximately 500 m north of the shoreline at an elevation of 7-10 masl. It covers an area of 2.76 ha, of which the cultivated area makes up 2.1 ha (Figure 2.5.1). Here, the total thickness of the clay till is approximately 8-10 m. Based on two profiles excavated in the buffer zone bordering the field the soil was classified as Anthric Luvisol and Anthric Stagnic Luvisol. The topsoil is characterised as sandy loam with a clay content of 13.7–16.7 % and organic carbon content of 0.9–1.7%.

The monitoring design for Lund is, as described in Haarder *et al.* (2021), similar to the other tile-drained clay till fields in PLAP (Silstrup, Estrup, and Faardrup) that are described in detail in Lindhardt *et al.* (2001). However, unlike the other clay till fields, there are no horizontal wells installed at Lund, as this requires knowledge of groundwater fluctuation to assess the optimal location and installation depths of such wells.

The monitoring period was initiated at Lund in April 2017. However, due to initial installation errors and lag in device installation, not all measurements were initiated. For example, precipitation measurements were obtained from February 25, 2018.

Monitoring of the drainage was initiated in July 2017 via a Thomson weir 30 V-notch. In March 2018, during a period of snowmelt, the flow of the drainage was obstructed, and water was retained in the drainage monitoring well thereby causing erroneous measurements. Hereafter, a pump was installed in the well preventing drainage water from damming up at the downstream side of the V-notch. The V-notch was repaired in June 2019, as the initial installation was not done properly. Consequently, the measurement of the high-intensity drainage may have been underestimated until June 2019. Drainage sampling for pesticide analyses started in November 2017.

The water content monitoring at S1 from 1.1 mbgs started September 1, 2017, whereas TDR measurements at S2 from 0.25, 0.60, and 1.1 mbgs, and at S1 from 0.25 and 0.60 mbgs were initiated June 30, 2018.

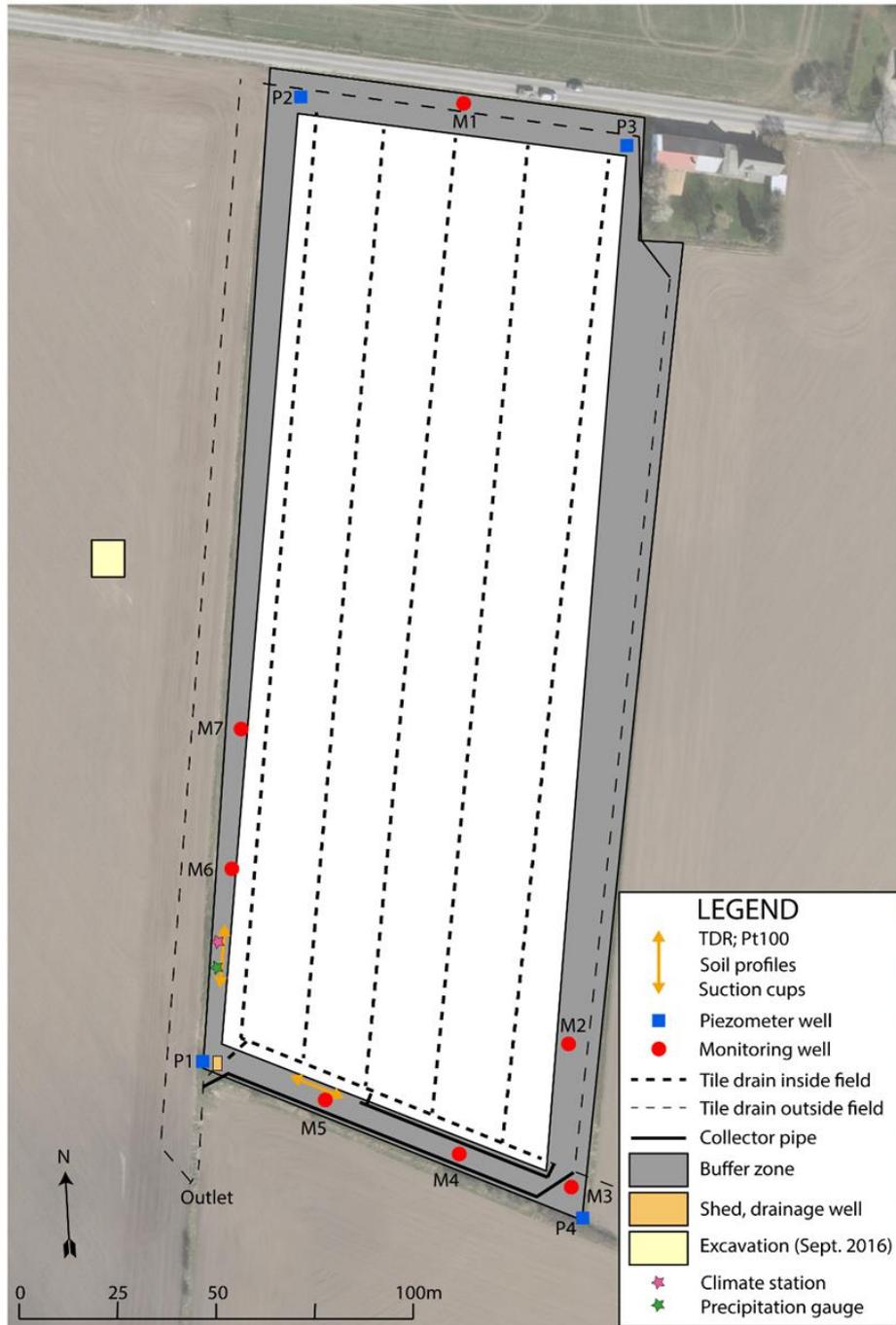


Figure 2.5.1. Overview of the Lund field. The innermost white area indicates the cultivated area, while the grey area indicates the surrounding buffer zone. The positions of the various installations are indicated, as is the direction of groundwater flow (arrow). Pesticide monitoring is conducted weekly from the tile drain system via a drainage well located underneath the shed (during periods of continuous drainage) and monthly from selected vertical monitoring well screens (Appendix 2). At S1 and S2, water content (via TDR) and soil temperature (via Pt100) is measured at four different depths. Additionally, suction cups are installed to collect pore water from the variably saturated matrix for analysis of pH-independent compounds.

As no existing climate station was located in the vicinity of the field, an automatic climate station from Campbell Scientific (UK) was installed in the buffer zone (Haarder *et al.*, 2021). The climate station ensures local measurements of precipitation, barometric pressure, global radiation, air temperature, relative humidity, wind speed, and direction. The precipitation measured with the Pluvio2 rain gauge (OTT Hydromet, Germany) was found to generally overestimate the precipitation when compared with the MACRO modelling for Lund. The overestimation was confirmed by comparison to i) precipitation obtained from the 10 km x 10 km grid (no. 10570) of Denmark (provided by The Danish Meteorological Institute, DMI), ii) Flakkebjerg, situated 60 km from Lund (provided by DMI), and iii) Tokkerup, situated 11 km from Lund (provided by Aarhus University, AU). It was not possible to correct the precipitation measured locally at Lund and therefore precipitation data from July 1, 2018, to July 6, 2021, were obtained from a research project at Tokkerup conducted by The Department of Agroecology, AU. Precipitation data for the remaining monitoring period was measured locally at the Lund field.

Groundwater level monitoring was initiated in April 2017 in piezometers, “P”, and monitoring wells, “M” (Figure 2.5.1). From July 1, 2019 samples were collected monthly from well M1, M4, and M5, and half-yearly from well M3 and M6. No samples were collected during the monitoring period from well M2 and M7. See Appendix 2 for details.

It should be noted that the bromide tracer test done at Lund in 2017, seemed to have been erroneous. Consequently, the hydraulic connectivity of the screens and the groundwater is yet unclear. This might affect the interpretation of the test, as the lack of detections can be a consequence of lacking hydraulic connectivity (refer to Chapter 6). The water dynamics at Lund are presently under evaluation and a new bromide tracer experiment will be conducted in January 2023.

## 2.6 Tylstrup

Due to economic constraints, the monitoring of pesticides and degradation products was put on stand-by at Tylstrup by the end of 2018. No new pesticide monitoring results from Tylstrup are presented in this current report, but the field description is kept as table 9.1 and 9.2 include historical data for the field.

Tylstrup is located in northern Jutland (Figure 1.2.1). The test field covers a cultivated area of 1.2 ha (70 m x 166 m) and is practically flat, with windbreaks bordering the eastern and western sides. Based on two soil profiles dug in the buffer zone around the test field, the soil was classified as a Humic Psammentic Dystrudept (Soil Survey Staff, 1999). The topsoil is characterised as loamy sand with 6% clay and 2% total organic carbon (Table 1.2.1). The aquifer material consists of an approximately 20 m thick layer of marine sand deposited in the Yoldia Sea. The southern part is rather homogeneous, consisting entirely of fine-grained sand, whereas the northern part is more heterogeneous due to the intrusion of several silt- and clay lenses (Lindhardt *et al.*, 2001). The overall direction of groundwater flow is towards west (Figure 2.6.1). Since the initiation of the monitoring in 1999, the groundwater table has fluctuated between 2.6–4.8 meters below ground surface, mbgs, (Badawi *et al.* 2022). In February 2009, water sampling from well M2, M6, and M7 was stopped (Appendix 2). In September 2011, the monitoring system at Tylstrup was extended with three horizontal screens (H1) 4.5 mbgs in the south-eastern corner of the field (Figure 2.6.1). A brief description of the drilling and design of H1 is given in Appendix 8. A new data logger was installed at Tylstrup on May 13, 2019. Unfortunately, the programme of the new data logger was defective and resulted in incorrect TDR data.

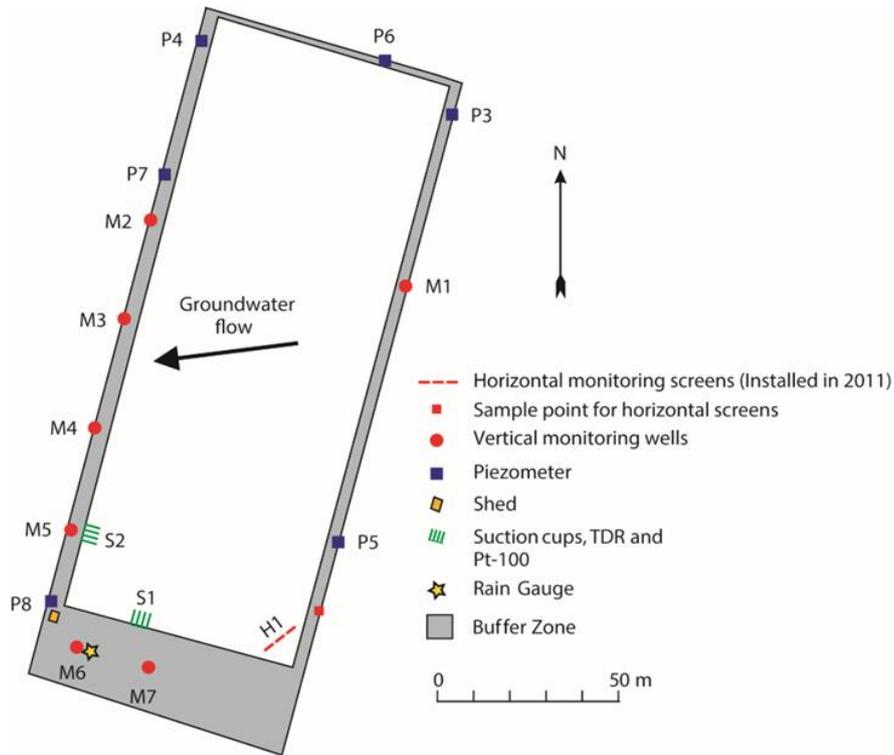


Figure 2.6.1. Overview of the Tylstrup field. The innermost white area indicates the cultivated area surrounded by the buffer zone. Pesticide monitoring was conducted monthly and half-yearly from suction cups and selected vertical and horizontal monitoring screens as described in section 2.6 and Appendix 2. At S1 and S2, water content (via TDR) and soil temperature (via Pt100) is measured at four different depths. Additionally, suction cups are installed to collect pore water from the variably saturated matrix for analysis of pH-independent compounds.

### 3. Agricultural management

Agricultural management of the five PLAP fields in Jyndeved, Silstrup, Estrup, Faardrup, and Lund included in the present monitoring is described below. The description covers the period from July 2019 up to harvest in August 2022, though relevant information from 2018 is included for some fields. The period covers the monitoring and evaluation period of pesticides included in the present report.

The Tylstrup PLAP field was put on standby by the end of 2018, but the field is still cultivated although not included in the pesticide monitoring. The agricultural management of the field is described in Appendix 3 and 7 (Table A3.1 and A7.1). Monitoring at Tylstrup can be resumed if needed.

Further information about agricultural management before 2019 can be found in previous reports available at [www.plap.dk](http://www.plap.dk), and detailed information on pesticide monitoring is in Chapter 6.

#### 3.1 Agricultural management at Jyndeved

Agricultural management practice at Jyndeved from June 2018 until August 2022 is briefly summarised below and detailed in Appendix 3 (Table A3.2). Detailed information on pesticide monitoring is described in Chapter 6 and Appendix 7 (Table A7.2).

##### **Winter wheat – harvest 2018**

On June 6, 2018, winter wheat at BBCH stage 70 was treated with the fungicide thiophanat-methyl, and the degradation product carbendazim was included in the monitoring programme. During the growing season, the field was irrigated with 30 mm eight times on May 13, 20 and 27, June 2, 6, 10 and 26 and July 4. The winter wheat was harvested on July 26 with a grain yield of 82.4 hkg/ha (85% dry matter) and straw yield of 44.8 hkg/ha (100% dry matter).

##### **Winter rye – harvest 2019**

On August 22, 2018, the field was sprayed with glyphosate, which was not included in the monitoring. On October 18, 2018, the field was ploughed and hereafter sown with winter rye (cv. Bono, coated with fludioxonil). The rye emerged on November 5, 2018. The crop was fertilised with 136.0, 26.0, and 65.0 kg/ha of N, P, and K on March 21, 2019, and with 63.0, 12.0, and 30.0 kg/ha of N, P, and K on April 17. A split application of proquinazid was made on April 25 and May 9, 2019, when the winter rye was at BBCH stages 31 and 41, respectively (Figure 3.1.1). Two of its degradation products, IN-MM671 and IN-MM991, were included in the monitoring programme. On May 8, 2019, the growth regulator ethephon was used together with the herbicide MCPA – neither of the two was monitored. A dry growing season necessitated irrigation seven times: April 11 and 22, May 5 and 24, June 8 and 26, and July 4, 2019 - each time applying 30 mm. Harvest of the winter rye was done August 11, 2019, yielding 69.2 hkg/ha of grain (85 % dry matter) and 36.5 hkg/ha of straw (100% dry matter).



Figure 3.1.1. Winter rye in the Jyndeved field on April 25 (left) and May 15 (right), 2019 (Photo: Henning Carlo Thomsen).

### Potatoes – harvest 2020

On February 3, 2020, the field was ploughed, and on April 25 planted with potatoes (cv. Kuras, not coated). Fertiliser was placed at planting: 28.0, 6.0, and 30.0 kg/ha of N, P, and K. Furthermore, 168.0 kg/ha N and 135.0 kg/ha K were added with a pneumatic fertiliser spreader. On May 20, the potatoes were at BBCH 08, and weeds in the field were sprayed with a mixture of glyphosate and clomazone. Neither of these pesticides was monitored. The potatoes emerged on May 24 (BBCH 09). They were irrigated with 20 mm on June 13 and 21, and with 30 mm on August 2, 8, and 15. Spraying against fungi was done six times with cyazofamid on June 14 and 23, July 17, August 12, and September 1 and 10, 2020. The BBCH stage of the potatoes at the times of treatment was 28, 41, 68, 77, 89, and 91, respectively (Figure 3.1.2). Three of its known degradation products (DMSA, CTCA, and CCIM) and one potential degradation product (DMS) were monitored. Two additional fungicides were used but not monitored: One containing propamocarb and cymoxanil was used twice (August 6 and 19), and another containing mancozeb was used six times (July 3, 9, and 27, August 3 and 27, and September 16). Pests were sprayed with azadirachtin on both August 12 and September 1 with the intention of monitoring for the degradation product azadirachtin H\*. However, as azadirachtin H\* was unstable in aqueous solution, it could not be analysed, and the compound will not be further discussed. Acetamiprid, another compound for pest control, was applied on June 23 and July 17 at BBCH stages 41 and 68, and two of its degradation products, IM-1-4 and IM-1-5, were included in the monitoring. Harvest of potatoes was done on October 21, 2020, yielding 142.8 hkg/ha (100% dry matter).



Figure 3.1.2. Potatoes on the Jyndevad field in 2020: June 14 (top left) and 23 (top right), July 17 (bottom left), August 15 (bottom middle) and 27 (bottom right) (Photos: Henning Carlo Thomsen).

### Winter rye – harvest 2021

After rotor cultivation of the field, winter rye (cv. Serafino, coated with prothioconazole and tebuconazole) was sown on October 21, 2020, and it emerged on November 5. The crop was fertilised with 54.6, 10.4, and 26.0 kg/ha N, P, and K, respectively, on March 8, 2021, and with 79.8, 15.4, and 38.0 kg/ha N, P, and K, respectively on April 7. The winter rye was irrigated three times on April 27, June 8 and 16 with 30, 27, and 35 mm, respectively. Only one spraying with MCPA against weeds was performed on April 20, and this was not monitored. The winter rye was harvested on August 20 with a grain yield of 59.6 hkg/ha (85% dry matter) and a straw yield of 42.3 hkg/ha (100% dry matter). On August 30, liming was done with 3.6 t/ha magnesium limestone.

### Spring barley – harvest 2022

The field was ploughed on February 1, 2022, and disc harrowed on February 2, where after spring barley (cv. Flair, coated with prothioconazole and tebuconazole) was sown on March 5. Fertilisation of the crop was split in three: on March 28, April 27, and May 5. Each time with 46.2, 8.8, and 21.0 kg/ha of N, P, and K. It was irrigated six times: On April 28, May 7, June 22 and July 13 with 20 mm and on May 19 and June 5 with 25 mm. The weeds in the field were treated with tribenuron-methyl on April 23, when the spring barley was at BBCH stage 22 (Figure 3.1.3). Three degradation products, IN-B5528, IN-R9805, and M2, were monitored. Spraying against fungi was done with prothioconazole and fluopyram on May 22, at barley BBCH stage 49 (Figure 3.1.3). Fluopyram and the degradation products fluopyram-7-hydroxy and 1,2,4-triazole were

included in the monitoring programme. Additional herbicide treatments were carried out with MCPA on May 18 and glyphosate on July 20. Neither of these was monitored. The spring barley was harvested on August 1 with a grain yield of 75.7 hkg/ha (85% dry matter) and straw yield of 38.6 hkg/ha (100% dry matter). The straw was shredded in the field after harvest.



Figure 3.1.3. Spring barley field in Jyndevad on April 23 (left) and May 22 (right), 2022 (Photos: Henning Carlo Thomsen).

### 3.2 Agricultural management at Silstrup

Agricultural management practice at Silstrup from August 2018 until August 2022 is briefly summarised below and detailed in Appendix 3 (Table A3.3). Detailed information on pesticide monitoring is described in Chapter 6 and Appendix 7 (Table A7.3).

#### Winter rapeseed – harvest 2019

On August 17, 2018, a crop of winter rapeseed (cv. Exclaim, coated with thiram) was sown directly into the barley stubble. Cycloxydim was used against weeds on September 17, 2018, when winter rapeseed was at BBCH stage 13-14, and its degradation products, BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO were included in the monitoring programme. Another spraying of weeds was done with propyzamide on November 9, 2018, in winter rapeseed at BBCH stage 18, after which propyzamide was included in the monitoring. The crop was fertilised with 81.0 kg/ha N on March 1, 2019, and pig slurry containing 92.8, 57.2, 21.6, and 37.0 kg/ha of total-N, NH<sub>4</sub>-N, P, and K, respectively, were applied on April 2. The herbicide propaquizifop was applied on April 9, 2019, in winter rapeseed at BBCH stage 54, and its degradation products, CGA 287422, CGA 294972, CGA 290291, and PPA, were monitored. Harvest of the winter rapeseed was done on August 14, 2019, yielding 44.5 hkg/ha of seeds (91% dry matter). An unknown amount of straw was shredded at harvest.

### **Winter wheat – harvest 2020**

On September 19, 2019, the field was ploughed. On September 21, a winter wheat (cv. Benchmark, coated with fludioxonil) was sown and the crop emerged on October 7, 2019. On March 25, 2020, it was fertilised with the following amounts of N, P, and K: 177.2, 25.3, and 84.4 kg/ha. Spraying of weeds was done on April 7, 2020, in winter wheat at BBCH stage 30, using pyroxsulam and florasulam in a mixture. From pyroxsulam, five degradation products were included in the monitoring: PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide. From florasulam, four degradation products were monitored: TSA, 5OH-florasulam, DFP-ASTCA, and DFP-TSA. Fungicides were sprayed twice, using prothioconazole together with azoxystrobin on May 28 and June 16, 2020, at winter wheat BBCH stage 42 and 68, respectively. From azoxystrobin, the degradation product CyPM was included in the monitoring, and 1,2,4-triazole from prothioconazole. On August 13, 2020, 97.0 hkg/ha of grain (85% dry matter) was harvested. The amount of straw shredded and left in the field at harvest was not determined.

### **Spring barley – harvest 2021**

The field was ploughed on September 28, 2020, and winter wheat (cv. Skyscraper, coated with difenoconazole) was sown on September 30. Due to a poor seedbed and late sowing of the winter wheat, the germination was deficient, and the crop emerged unevenly. Therefore, it was decided to wither away the plants with glyphosate on March 31, 2021. This pesticide was not monitored. On April 15, a mixture of varieties of spring barley (not coated) was sown and fertilised with N, P, and K: 136.9, 19.6, and 65.2 kg/ha. Foliar fertilisation with 0.11 kg/ha N and 0.24 kg/ha Mn was done contemporary with spraying against weeds with MCPA (not monitored) on June 10. On June 30, the barley was at BBCH stage 61, and it was treated with the fungicides prothioconazole and fluopyram. Fluopyram was included in the monitoring, whereas 1,2,4-triazole was continuously monitored. The spring barley was harvested on August 23 with a grain yield of 53.7 hkg/ha (85% dry matter). The straw yield was not determined, but it was shredded and left in the field.

### **Winter wheat – harvest 2022**

The field was ploughed on September 19, 2021, and winter wheat (cv. Herup, coated with fludioxonil and tebuconazole) was sown on September 21. The crop emerged shortly before October 13, 2021, when it was at BBCH stage 11. It was fertilised with 197.4, 28.2, and 94.0 kg/ha of N, P, and K on April 5, 2022. Spraying against weeds was performed with tribenuron-methyl and metsulfuron-methyl on April 29 at BBCH stage 31 of winter wheat. The degradation products IN-B5528, IN-R9805, and M2 from tribenuron-methyl were included in the monitoring. On May 4 and June 10, 2022 (Figure 3.2.1), the crop was at BBCH stage 32 and 60, respectively, and it was treated with the fungicides prothioconazole and fluopyram. Fluopyram and 1,2,4-triazole monitoring continued and the degradation product fluopyram-7-hydroxy from fluopyram was included. The winter wheat was harvested on August 16 with a grain yield of 94.0 hkg/ha (85% dry matter). The straw yield was 86.8 hkg/ha (100% dry matter). It was shredded and left in the field after harvest.



Figure 3.2.1. Winter wheat at the Silstrup field, May 4 (left) and June 10 (right), 2022 (Photos: Helle Baadsgaard and Kaj Madsen).

### 3.3 Agricultural management at Estrup

Agricultural management practice at Estrup from June 2018 until August 2022 is briefly summarised below and detailed in Appendix 3 (Table A3.4). Further information on pesticide monitoring is provided in Chapter 6 and Appendix 7 (Table A7.4).

#### Winter wheat – harvest 2018

Winter wheat at BBCH stage 68-69 was sprayed with the fungicide thiophanate-methyl on June 6, 2018, and the degradation product carbendazim was included in the monitoring. The winter wheat was harvested on July 27 with a grain yield of 75.2 hkg/ha (85% dry matter) and a straw yield of 37.9 hkg/ha (100% dry matter). The straw was shredded at harvest and left in the field.

#### Spring barley – harvest 2019

The field was ploughed on November 5, 2018. On April 8, 2019, a spring barley (cv. Flair, coated with prothioconazole and tebuconazole) was sown and fertilised with 137.0, 26.0, and 65.0 kg/ha of N, P, and K. On April 17, 2019, the barley emerged. The herbicides fluroxypyr and halauxifen-methyl were sprayed on May 22, 2019, when spring barley was at BBCH stage 31. Only X-729 (halauxifen or X11393729), a degradation product from halauxifen-methyl, was included in the monitoring programme. A split application of metconazole against fungi was done on May 22 and June 13, at BBCH stages 31 and 50, respectively. 1,2,4-triazole was continuously monitored and metconazole was included in the monitoring. Harvest of the spring barley took place on August 11, 2019, yielding 70.4 hkg/ha of grain (85% dry matter), whereas 23.3 hkg/ha of straw (100% dry matter) was shredded and left in the field.

#### Winter wheat – harvest 2020

Ploughing of the field, as well as the sowing of winter wheat (cv. Sheriff, coated with prothioconazole and tebuconazole), was done on September 16, 2019. The winter wheat emerged on September 26, 2019 and was sprayed with the herbicide pendimethalin on October 7, 2019 (not monitored). The winter wheat was fertilised with N, P, and K twice: On April 7 and 15, 2020. At first, 136.5, 26.0, and 65.0 kg/ha of N, P, and K were applied, whereas at the second application, the respective amounts of N, P, and K were 73.5, 14.0, and

35.0 kg/ha. Further spraying of weeds was done on May 3, when winter wheat was at BBCH stage 31 (Figure 3.3.1), using a mixture of pyroxsulam and florasulam. From pyroxsulam five degradation products were included in the monitoring: PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide. From florasulam four degradation products were included in the monitoring: TSA, 5-OH-florasulam, DFP-ASTCA, and DFP-TSA. Harvest of the winter wheat on August 11, 2020, yielded 71.4 hkg/ha of grain (85% dry matter) and 38.4 hkg/ha of straw (fresh weight). The straw was shredded at harvest and left in the field.

### Spring barley – harvest 2021

On February 2, 2021, a total of 3.5 t/ha of magnesium limestone was added to the field. Spring barley (cv. Flair, coated with prothioconazole and tebuconazole) was sown on April 19. Two days later it was fertilised with 120.0, 22.8, and 57.0 kg/ha N, P, and K, and it emerged before April 27, where it was recorded to have reached BBCH stage 11. On June 1, 2021, at BBCH stage 27 (Figure 3.3.1), it was sprayed with the herbicide thifensulfuron-methyl. The applied amount of thifensulfuron-methyl was 9 g/ha, which is higher than the maximum allowed dose of 7.5 g/ha in spring cereals. The degradation products IN-JZ789, IN-B5528, and IN-L9223 were included in the monitoring programme. The spring barley was harvested on August 15 with a grain yield of 44.6 hkg/ha (85% dry matter) and a straw yield of 29.0 hkg/ha (100% dry matter). The straw was shredded and left in the field.



Figure 3.3.1. Figure Crops at the Estrup field. Winter wheat on May 3, 2020 (left) and spring barley on June 2, 2021 (right) (Photos: Henning Carlo Thomsen).

### Perennial ryegrass – harvest 2022

On August 23, 2021, a mixture of perennial ryegrass varieties (Foragemax33) was sown, and it emerged on September 1. The ryegrass was fertilised with N, P and K three times, each time with 63.0, 12.0 and 30.0 kg/ha. The first fertilisation was on April 1, 2022, whereas the second and third were on June 2 and July 6 after the first and the second cut, respectively. Spraying against weeds with thifensulfuron-methyl was performed on July 19, at ryegrass BBCH stage 30 (Figure 3.3.2), and monitoring of the degradation products IN-JZ789, IN-B5528 and IN-L9223 continued. In total, three cuts of grass were done in 2022: On May 31, July 4 and August 8, yielding 26.7, 24.1 and 25.0 hkg/ha (100% dry matter), respectively.



Figure 3.3.2. The perennial ryegrass in the Estrup field on July 19, 2022 (Photo: Henning Carlo Thomsen).

### 3.4 Agricultural management at Faardrup

Management practice at Faardrup from April 2019 until August 2022 is briefly summarised below and detailed in Appendix 3 (Table A3.5). Detailed information on pesticide monitoring is found in Chapter 6 and Appendix 7 (Table A7.5).

#### Spring barley – harvest 2019

On April 8, 2019, spring barley (cv. IKWS Irina, coated with prothioconazole and tebuconazole) was sown. On April 9, it was fertilised with 113.3, 19.8 and 52.8 kg/ha N, P and K. On April 15, 2019, the barley emerged. Spraying of weeds with diflufenican was done on April 26 (not monitored). Applications of proquinazid against fungi were done on June 3 and 17, 2019, at BBCH stages 32 and 45, respectively. Its degradation products IN-MM671 and IN-MM991 were included in the monitoring. Harvest of the spring barley was done on August 12, 2019, where yields of grain were 82.0 hkg/ha (85 % dry matter). The amount of straw shredded and left in the field was 35.5 hkg/ha (fresh weight).

#### Spring wheat – harvest 2020

Ploughing of the field was done on November 15, 2019. Spring wheat (cv. Cornette, coated with fludioxonil, not monitored) was sown on March 26, 2020, fertilised with 134.0, 26.0 and 65.0 kg/ha N, P and K on April 2, and it emerged on April 6. On May 20, the weeds were treated with bromoxynil (not monitored). At harvest on August 14, 2020, yields of grain were 56.5 hkg/ha (85% dry matter), and 43.1 hkg/ha (100% dry matter) of straw was shredded and left in the field.

#### Winter rapeseed – harvest 2021

Immediately after harvest on August 14, 2020, the field was ploughed and winter rapeseed (cv. V3160L, coated with *Bacillus amyloliquefaciens* MBI 600) was sown. Before crop emergence, the field was sprayed with the herbicide clomazone on September 1, 2020 (not monitored). The crop emerged on September 9, 2020. On November 25, at winter rapeseed BBCH stage 15, another herbicide treatment was carried out with

propyzamide. Propyzamide was included in the monitoring. The crop was fertilised twice with N, P and K with the amounts 123.6, 21.6 and 60.0 kg/ha on March 9, 2021, and 97.9, 3.5 and 47.5 kg/ha on April 13. A treatment against fungi was made with prothioconazole and fluopyram at crop BBCH stage 69 on May 26, 2021. Fluopyram was included in the monitoring and 1,2,4-triazole was continuously monitored. The winter rapeseed was harvested on August 11 with a seed yield of 29.6 hkg/ha. The stubble was shredded at harvest.

### Winter wheat – harvest 2022

On September 28, 2021, the field was sprayed with the herbicide glyphosate (not monitored). It was ploughed on October 7, and winter wheat (cv. Rembrandt, coated with prothioconazole and tebuconazole) was sown the following day. The crop emerged on October 22, 2021, and it was fertilised with N, P and K twice in 2022 with the amounts: 98.7, 18.8 and 47.0 kg/ha on March 9, and 57.8, 11.0 and 27.5 kg/ha on April 27. The herbicides tribenuron-methyl and metsulfuron-methyl were applied on April 21, 2022, at wheat BBCH stage 28 (Figure 3.4.1). The degradation products IN-B5528, IN-R9805 and M2 from tribenuron-methyl were included in the monitoring. The fungicides prothioconazole and fluopyram were applied twice in 2022: On May 4 and 30 at BBCH stages 31 and 51, respectively (Figure 3.4.1). Monitoring of fluopyram and 1,2,4-triazole continued, and the degradation product fluopyram-7-hydroxy from fluopyram was included in the monitoring. The winter wheat was harvested on August 11, 2022.



Figure 3.4.1. Winter wheat on the Faardrup field on April 19 (top left), May 4 (top right) and June 7 (bottom), 2022 (Photos: Eugène J.G.G. Driessen).

### 3.5 Agricultural management at Lund

Management practice at Lund during the 2018-2022 growing seasons is briefly summarised below and detailed in Appendix 3 (Table A3.6). Further information on pesticide monitoring is provided in Chapter 6 and Appendix 7 (Table A7.6).

#### Spring barley – harvest 2018

Ploughing of the field was done on January 4, 2018. Pig slurry containing 131.5, 113.5, 3.0 and 72.5 kg/ha of total-N, NH<sub>4</sub>-N, P and K, respectively, was applied on April 19. Spring barley (cv. Quench, coated with prothioconazole and tebuconazole) was sown on April 20, and it emerged on May 1. A mixture of the fungicide prothioconazole and the herbicides halauxifen-methyl and florasulam was sprayed in the field on May 30, 2018, when the barley was at BBCH stage 31. The degradation product, TSA from florasulam was included in the monitoring and 1,2,4-triazole was continuously monitored. A second spraying with prothioconazole against fungi was done on June 12, at barley BBCH stage 42. The spring barley was harvested on August 6, 2018, yielding 55.5 hkg/ha of grain (85% dry matter) and 22.4 hkg/ha of straw (100 % dry matter).

#### Winter barley – harvest 2019

The field was ploughed on September 18, 2018, and sown with winter barley (cv. Memento, coated with prothioconazole and tebuconazole) the following day. On September 28, 2018, the winter barley had emerged, and on May 2, 2019, it was fertilised with 150.0, 26.3 and 70.0 kg/ha N, P and K. Diflufenican together with prosulfocarb was used against weeds on November 8, 2018 (neither were monitored). The herbicide fluroxypyr was applied on May 9, 2019 (not monitored). On May 11, when barley was at BBCH stage 49, the field was sprayed with halauxifen-methyl and florasulam. The degradation product TSA from florasulam was continuously monitored (since April 2018) and degradation product X-729 from halauxifen-methyl was included in the monitoring. Harvest of winter barley was done on July 13, 2019, where the grain yield was 66.4 hkg/ha (85% dry matter) and that of straw was 35.9 hkg/ha (fresh weight).

#### Winter rapeseed – harvest 2020

On August 25, 2019, the field was power harrowed and subsequently winter rapeseed (cv. InVigor 1030, coated with *Bacillus amyloliquefaciens* MBI 600) was directly drilled. On August 28, glyphosate and clomazone were used against weeds, but not included in the monitoring programme. The winter rapeseed emerged on August 30. It was fertilised on September 5, 2019, with 19.2 and 7.4 kg/ha of N and P. On December 17, 2019, when the winter rapeseed was at BBCH stage 13 (Figure 3.5.1), the pesticides propyzamide, picloram, and halauxifen-methyl were used against weeds. This application was performed too early, as winter rapeseed should have been at minimum growth stage BBCH 15, when sprayed with propyzamide according to Danish regulations. Furthermore, 5 g halauxifen-methyl was applied per hectare, and the growth stage of winter rapeseed should have been at least BBCH 16 for using this amount of active ingredient. The degradation product from halauxifen-methyl, X-729 was continuously monitored. Propyzamide and the two degradation products, RH-24644 and RH-24580, and picloram were included in the monitoring. The crop was fertilised twice in 2020: With 97.9, 19.0 and 47.5 kg/ha of N, P and K on March 23 and 80.3, 15.6 and 39.0 kg/ha of N, P and K on April 24. Harvest of the winter rapeseed was done on August 1, 2020, yielding 49.2 hkg/ha of seeds (fresh weight). The straw yield was not measured before being shredded at harvest.



Figure 3.5.1. Winter rapeseed at the Lund field December 17, 2019 (Photo: Jesper Hjort D. Petersen).

### Winter wheat – harvest 2021

On September 18, 2020, the field was ploughed, and two days later winter wheat (cv. Sheriff, coated with prothioconazole and tebuconazole) was sown. The crop emerged on September 29, 2020, and was treated with the herbicide bromoxynil on November 6, 2020 (not monitored). The winter wheat was fertilised with 151.0, 29.0 and 72.0 kg/ha of N, P and K on April 1, 2021. The fungicides prothioconazole and fluopyram were applied on June 9, 2021, at winter wheat BBCH stage 59. Fluopyram was included in the monitoring programme, whereas the common degradation product from azoles, 1,2,4-triazole was continuously monitored. The winter wheat was harvested on August 19 and 21, 2021, yielding 92.0 hkg/ha (85% dry matter) of grain and 50.8 hkg/ha (fresh weight) of straw.

### Spring barley – harvest 2022

The field was ploughed on February 14, 2022, and fertilised with 126.0, 18.0 and 60.0 kg/ha of N, P and K on March 20, before sowing spring barley (cv. Laureate, coated with prothioconazole and tebuconazole) on March 23. The herbicide tribenuron-methyl was applied on May 10, when barley was at BBCH stage 24 (Figure 3.5.2), which was slightly too early, as a spraying with the used dosage of 7.5 g/ha should have been performed at spring barley BBCH stage 28 or later according to Danish regulations. The tribenuron-methyl degradation products IN-B5528, IN-R9805 and M2 were included in the monitoring. One fungicide application with prothioconazole and fluopyram was done on May 31, at spring barley BBCH stage 48 (Figure 3.5.2). Monitoring of fluopyram and 1,2,4-triazole continued and the degradation product fluopyram-7-hydroxy from fluopyram was included in the monitoring. On August 10, 2022, the spring barley was harvested with a grain yield of 88.5 hkg/ha (fresh weight) and straw yield of 39.5 hkg/ha (fresh weight).



Figure 3.5.2. Spring barley field in Lund on May 10 (left) and 31 (right), 2022 (Photos: Eugène J.G.G. Driessen).



## 4. Soil water dynamics

The water balance at all fields is assessed through monitoring of hydrological variables and numerical modelling. The numerical modelling is conducted using MACRO 5.2 (Larsbo *et al.*, 2005). As such, the monitoring of the hydrological variables from each of the fields is used in a combination of model driving data and observations. All PLAP fields have a similar design in terms of monitoring instrumentation (Chapter 2) and, thus locally measured climate data are used as driving data, while current observation data in the model comprises groundwater levels, soil water content at various depths, as well as drainage flow on the clay till fields.

The treated area of each PLAP field is represented by a one-dimensional model which covers the upper five meters of the soil profile and always includes the groundwater table. Soil characteristics for each field were based on the pedological profiles that were described for each PLAP field at the time of establishment (Lindhardt *et al.*, 2001; Haarder *et al.*, 2021). One model for each field was set up and used to simulate water dynamics in the variably saturated zone during the full monitoring period and to establish an annual water balance. Compared to the setup in Badawi *et al.* (2022), two years of climate and crop data (from July 2020 to June 2022) were added to the current MACRO setup. For the fields Jyndevad, Silstrup, Estrup, and Faardrup the model was calibrated for the monitoring period from May 1999 to June 2004 and subsequently used to compare simulated water balance with monitoring results from July 2004 to June 2022. As the Lund field was established in 2017 and data collection at the field was initiated in 2017/2018, the model for Lund is preliminary and will be updated as more data is collected. The following types of measured data were used in the calibration process: Daily time series of the groundwater table measured in piezometers located in the buffer zone; soil water content based on TDR-measurements at three different depths (0.25, 0.6, and 1.1 mbgs) from the two profiles S1 and S2; and bromide concentrations measured in suction cups located at 1 and 2 mbgs. Data acquisition, model setup, and results related to the modelling are described in Barlebo *et al.* (2007).

Currently, the models are being updated and re-calibrated using state-of-the-art inverse calibration routines and utilizing the relatively long time series that have been collected since 2004. As the models become updated, these will be detailed in upcoming PLAP reports. In the current report, the latest model results are shown together with measured observations as done in previous reports. However, in contrast to previous reports, where simulation and observation results from 1999-end of the current reporting period were included, the results from the past three years (Jan 2019-June 2022) are now detailed in Figures 4.1.1, 4.2.1, 4.3.1, 4.4.1, and 4.5.1. The aim is to make it clearer how the model performs quantitatively compared to observed data within the current reporting period. Further, the shorter plotting periods aid to infer, whether a monitoring device is performing as expected. That is, with a shorter display interval, the qualitative performance (e.g., related to drifting issues) of a measuring device and data collection gaps are easily displayed.

It is noted that some simulation results may deviate slightly from previously published results. The reason is that various model parameter values were corrected for instances where typos occurred in the model input files. Similarly, the water balance contributions reported in the tables within the current chapter may deviate from the formerly reported periods.

## 4.1 Jynde vad

The measured groundwater levels from various intakes show that levels were rarely less than 1 mbgs. In the past three years, the groundwater level in both P9.2 and P11.2 was less than 1 mbgs during one period (February-April 2020). The two automatic loggers from P9.2 and P11.2 showed that the measured groundwater dynamics vary similarly and are offset by approximately 0.2 m (Figure 4.1.1B). As both wells are located at a terrain elevation of around 15 meters above sea level (masl), the offset is consistent with the general groundwater flow from the upstream well P11 towards the downstream well P9 (Figure 2.1.1 Chapter 2, Jynde vad). Overall, the simulated groundwater level fluctuation temporally follows the observations in terms of measured maximum and minimum levels, although the simulated groundwater level amplitude is less than what is measured. Therefore, the simulated maximums are lower than the observed and vice versa for simulated minimums (Figure 4.1.1).

The soil water saturation deduced from TDR-measured soil water content at S1 and S2 showed that differences between measurements were largest at 1.1 mbgs (Figure 4.1.1C-E). Generally, the soil water saturation dynamics were similar in S1 and S2 in depths of 0.25 and 0.6 mbgs. Also, the simulated soil water saturation at these depths followed the measured dynamics although showing an offset of around 10% in 0.25 mbgs. In 1.1 mbgs, an offset in S2 occurred in May 2019. This was due to errors in the software of the new data logger installed in Jynde vad on 2 May 2019, and therefore no S2 soil water content measurements at 1.1 mbgs were obtained after May 2021. It is noted that the simulated soil water saturation in 1.1 mbgs, although offset around 20%, followed the measured soil water saturation in S1 (Figure 4.1.1E). Further, the increase in measured soil water saturation observed around February-April 2020 was also captured by the model. This increase in soil water saturation was not observed or simulated in 0.25 and 0.6 mbgs. However, the soil water saturation increase in 1.1 mbgs coincides with the increase in the measured groundwater levels (Figure 4.1.1E and B) and corroborates with the increase in groundwater level to above 1.1 mbgs, but not reaching TDRs in 0.25 and 0.6 mbgs (Figure 4.1.1C, D).

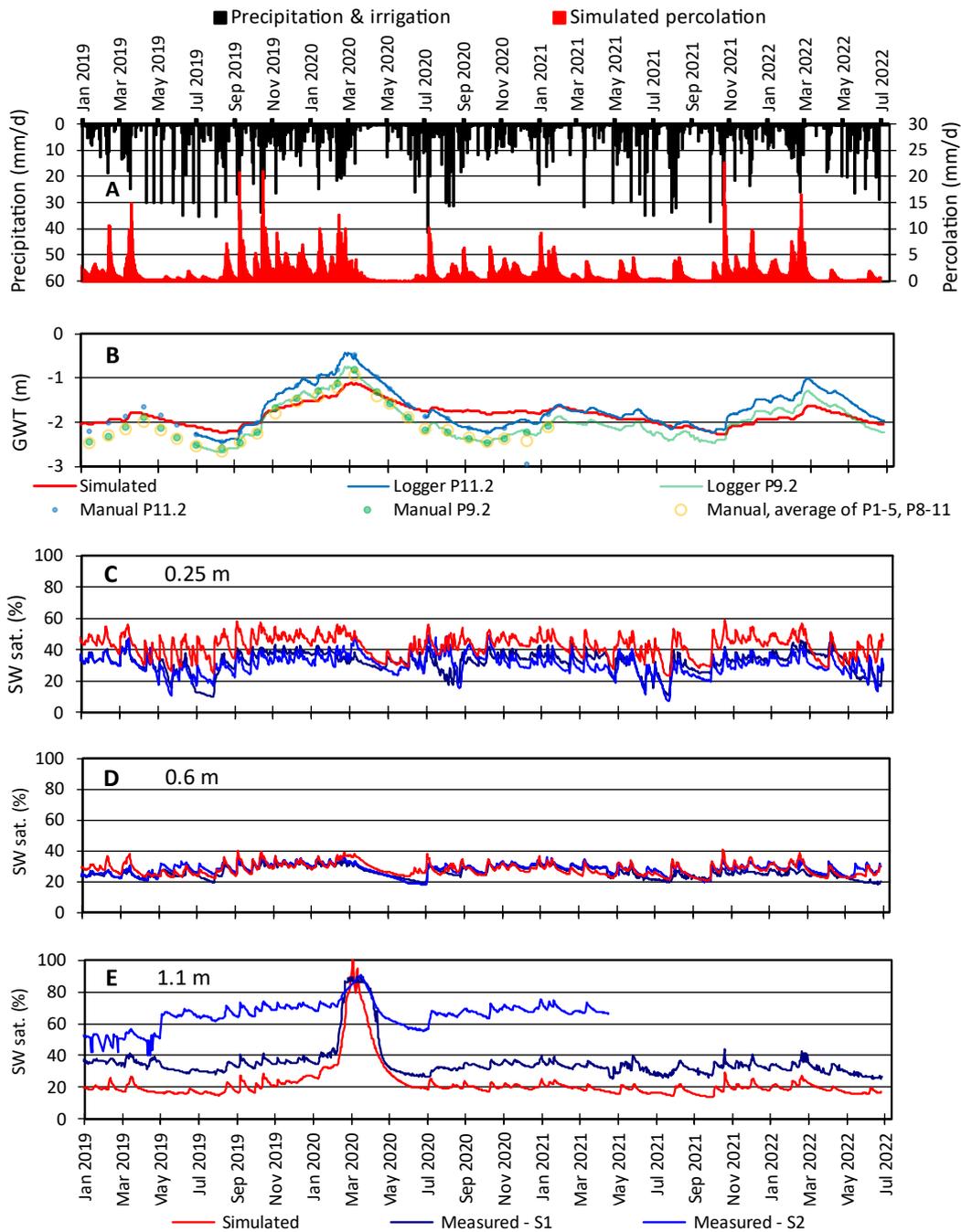


Figure 4.1.1. Hydrological components at Jynde vad. Measured precipitation including irrigation and simulated percolation 1 mbgs (A), depth to measured- and simulated groundwater table, GWT (B), measured soil water saturation (SW sat.) at indicated soil depths (C, D, and E). The measured data in B comprises piezometers located in the buffer zone. The measured data in C, D, and E are from TDR probes at S1 and S2.

The estimated yearly water balance for Jynde vad is shown in Table 4.1.1. The measured precipitation in 2021 and 2022 was 10 and 2% lower compared to the average. The simulated actual evaporation was higher than the average by 6 and 2% for 2021 and 2022, respectively indicating an increase in irrigation demands. This corroborates with an increase in actual irrigation at the field, which increased as much as 90% in 2021 and 15% in 2022 compared to the average. The estimated recharge for 2021 and 2022 decreased by 8 and 3% compared to the average and seemed to follow the decrease in precipitation.

Table 4.1.1. Annual water balance for Jyndevad (mm/yr).

	Normal precipitation <sup>1)</sup>	Precipitation <sup>2)</sup>	Irrigation	Actual evapotranspiration <sup>3)</sup>	Groundwater recharge <sup>4)</sup>
01.07.99–30.06.00	995	1073	29	500	602
01.07.00–30.06.01	995	810	0	461	349
01.07.01–30.06.02	995	1204	81	545	740
01.07.02–30.06.03	995	991	51	415	627
01.07.03–30.06.04	995	937	27	432	531
01.07.04–30.06.05	995	1218	87	578	727
01.07.05–30.06.06	995	857	117	490	484
01.07.06–30.06.07	995	1304	114	571	847
01.07.07–30.06.08	995	1023	196	613	605
01.07.08–30.06.09	995	1078	84	551	610
01.07.09–30.06.10	995	1059	80	530	610
01.07.10–30.06.11	995	1070	92	554	607
01.07.11–30.06.12	995	1159	30	490	699
01.07.12–30.06.13	995	991	60	478	572
01.07.13–30.06.14	995	1104	75	485	693
01.07.14–30.06.15	995	1267	102	569	800
01.07.15–30.06.16	995	1365	105	581	888
01.07.16–30.06.17	995	1031	60	531	559
01.07.17–30.06.18	995	1230	210	570	870
01.07.18–30.06.19	995	805	240	569	477
01.07.19–30.06.20	995	1188	70	494	877
01.07.20–30.06.21	995	991	182	560	613
01.07.21–30.06.22	995	1073	110	538	645
Average	995	1096	96	528	665

<sup>1)</sup> Normal values based on time series for 1961–1990 corrected to the soil surface (Olesen, 1991). <sup>2)</sup> Precipitation is corrected to the soil surface according to the method of Allerup and Madsen (1979). <sup>3)</sup> Actual evapotranspiration is estimated by the MACRO model applying climate data including potential evapotranspiration. <sup>4)</sup> Groundwater recharge is calculated as precipitation + irrigation - actual evapotranspiration.

## 4.2 Silstrup

The measured groundwater levels from various intakes showed that the levels fluctuated around approximately 1 mbgs during periods with drainage flow (Figures 4.2.1B and C). The loggers from P3.2 and M7.4 both seemed to fluctuate around 1 mbgs during drainage periods, while they were offset by approximately 1 m in periods without drainage. The measured levels in M7.4 were more surface-near relative to P3.2 and were likely related to the terrain sloping downwards from P3 at around 45 masl towards M7 at around 41 masl. Hence, the measured groundwater levels were consistent with the general groundwater flow from the upstream well, P3 to the downstream well, M7 (Figure 2.2.1, Chapter 2, Silstrup). The elevated groundwater levels fluctuating around 1 mbgs in periods of drainage were likely related to the drain depth. When the monitoring fields characterised as clay till were established, it was numerically assessed that the drain depths were approximately between 1-1.3 mbgs (e.g., Kjær et al, 2004). Therefore, the fluctuating groundwater levels around 1 mbgs indicate, that the drainpipes collect sufficient water to maintain the groundwater level around 1 mbgs. The simulated groundwater level captured the measured dynamics of the groundwater levels, especially during drainage. Hence, similar to the observed groundwater levels during drainage, where the groundwater levels fluctuated around 1 mbgs, the simulated levels also fluctuated around 1 mbgs (Figure 4.2.1B). Overall, the simulated drainage was temporally comparable to measured drainage meaning that drainage events were simulated when drainage also was measured. Still, there is a pattern of simulated drainage being overestimated (Figure 4.2.1C and Table 4.2.1).

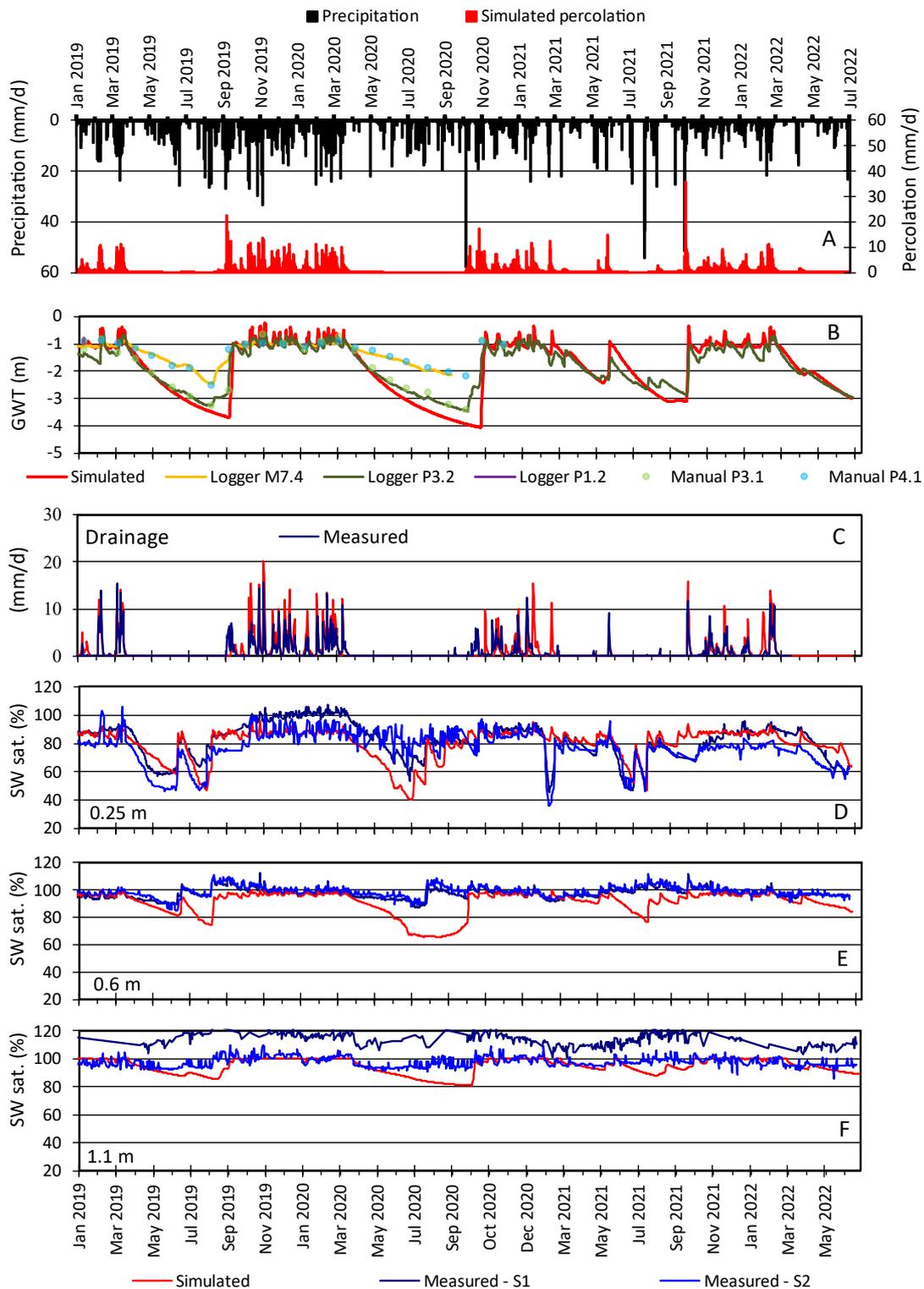


Figure 4.2.1. Soil water dynamics at Silstrup: Measured precipitation and simulated percolation 1 mbgs (A); simulated and measured groundwater table, GWT (B); simulated and measured drainage (C); and simulated and measured soil water saturation (SW sat.) at three different depths (D, E, and F). The measured data in B comprises piezometers located in the buffer zone. The measured data in D, E, and F from TDR probes installed at S1 and S2 (Figure 4.1).

The soil water saturation deduced from TDR-measured soil water content at S1 and S2 showed that differences between measurements were largest at 0.25 and 1.1 mbgs (Figure 4.2.1D-F). At 0.25 and 1.1

mbgs, the offset between the measured values at S1 and S2 was around 10 and 20%, respectively. The measured dynamics at S1 and S1 in 0.25 mbgs were generally similar, whereas periods with high/low soil water saturation were not coincident between S1 and S2 in 1.1 mbgs. Further, data from the measured time series of S1 were removed after being assessed as erroneous, and therefore, the time series is smoothed in some periods compared to S2 (Figure 4.2.1F). Overall, some of the calculated soil water saturation exceeded 100% and this is merely an artefact from the applied saturated volumetric water content in the saturation calculation, which was similar to what was used in the model for the given depths of measured soil water content.

Table 4.2.1. Annual water balance for Silstrup (mm/yr).

	Normal precipitation <sup>2</sup>	Precipitation <sup>3)</sup>	Actual evapotransp. <sup>4</sup>	Measured drainage	Simulated drainage	Groundwater recharge <sup>15</sup>	Groundwater recharge <sup>26</sup>
01.07.99–30.06.00 <sup>1)</sup>	976	1175	457	-	443	275	-
01.07.00–30.06.01	976	909	443	217	232	249	234
01.07.01–30.06.02	976	1034	474	227	279	334	281
01.07.02–30.06.03	976	879	537	81	74	261	268
01.07.03–30.06.04	976	760	517	148	97	94	145
01.07.04–30.06.05	976	913	506	155	158	252	249
01.07.05–30.06.06	976	808	504	101	95	203	208
01.07.06–30.06.07	976	1153	543	361	307	248	302
01.07.07–30.06.08	976	882	438	200	184	243	260
01.07.08–30.06.09	976	985	537	161	260	286	187
01.07.09–30.06.10	976	835	395	203	225	237	214
01.07.10–30.06.11	976	1063	402	172	569	489	92
01.07.11–30.06.12	976	1103	432	230	321	441	349
01.07.12–30.06.13	976	1020	455	249	333	316	232
01.07.13–30.06.14	976	1067	556	275	335	236	175
01.07.14–30.06.15	976	1314	462	329	412	523	440
01.07.15–30.06.16	976	1200	352	293	517	555	332
01.07.16–30.06.17	976	871	402	95	228	374	240
01.07.17–30.06.18	976	984	539	233	520	212	-75
01.07.18–30.06.19	976	1103	435	226	316	442	351
01.07.19–30.06.20	976	1334	523	440	600	371	212
01.07.20–30.06.21	976	988	442	207	225	339	321
01.07.21–30.06.22	976	988	411	217	298	359	278
Average	976	1016	468	219	306	319	241

<sup>1)</sup> The monitoring started in April 2000. <sup>2)</sup> Normal values based on time series for 1961–1990 corrected to soil surface (Olesen, 1991).

<sup>3)</sup> Precipitation is corrected to the soil surface according to the method of Allerup and Madsen (1979). <sup>4)</sup> Actual evapotranspiration is estimated by the MACRO-model applying climate data including potential evapotranspiration <sup>5)</sup> Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-measured drainage. <sup>6)</sup> Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-simulated drainage.

Generally, the simulated soil water saturation dynamics from January 2019 to July 2022 were similar to the measured in 0.25 mbgs. The simulated soil water saturation dynamics in 0.6 and 1.1 mbgs were not consistent with the measurements, especially during March-October 2020 in periods with low groundwater table (e.g., Figures 4.2.1B and F). During these periods, the simulated soil water saturation was lower compared to what was measured. It is noted that the simulated groundwater level was also lower than what was observed and consequently, the simulated soil water content was lower compared to the measured. However, all groundwater measurements showed groundwater deeper than 1 mbgs during March-October 2020, why soil water saturation should likely have decreased. This could indicate that locally around S1 and S2, the soil water saturation was higher than what was inferred from the groundwater measurements or simply that the measurements from the TDRs were erroneous.

The estimated yearly water balance for Silstrup is shown in Table 4.2.1. The measured precipitation in 2021 and 2022 were similar and 3% lower compared to the average. The simulated actual evaporation was lower than the average by 6% and 12% for 2021 and 2022. The measured drainage was 5% and 1% lower than the average for 2021 and 2022 while the simulated drainage was 26% and 2% lower compared to the average. It is noted that the groundwater recharge estimates are modified to include two different methods rather than one (as seen in previous PLAP reports). The recharge estimate method used hitherto was the following:

*Groundwater recharge1 = precipitation – simulated actual evapotranspiration – measured drainage,*

and the currently added is:

*Groundwater recharge2 = precipitation – simulated actual evapotranspiration – simulated drainage.*

The added recharge estimate represents the simulated groundwater recharge while the previous method yields a groundwater recharge estimate based on a mix of simulated and measured data. The estimated groundwater recharge with the recharge1 method for 2021 and 2022 increased by 6 and 12% compared to the average. With the recharge2 method, the estimated groundwater recharge for 2021 and 2022 increased by 33 and 15% compared to the average. In terms of absolute values, it is evident that the two recharge estimation methodologies yield different values as the difference in yearly average is 78 mm/yr. Hence, the recharge estimated from the simulated results (recharge2 method) was 25% lower compared to groundwater recharge estimated from the recharge1 method (Table 4.2.1).

### 4.3 Estrup

The measured groundwater levels from various intakes show that the levels were generally at their maximum during periods of drainage (Figures 4.3.1B and C). The loggers from P1 and P3 showed similar dynamics, although the observations were offset around 1 m. The measured levels in P3.1 were more surface-near relative to the measured levels in P1.1 and were likely related to the terrain sloping downwards from P1 at around 58 masl to P3 at around 56 masl. This was consistent with the general groundwater flowing from the upstream well, P1 towards the downstream well, P3 (Figure 2.3.1 Chapter 2, Estrup). When groundwater levels were elevated during drainage, it is noted that the groundwater levels fluctuated less than one meter, which was substantially lower compared to the groundwater level decline following drainage cessation (Figures 4.3.1B and C). Further, it is noted that the maximum elevation measured at the two wells was offset, which deviates from the observations at the other clay till field Silstrup, where upstream and downstream wells had comparable groundwater levels during drainage (Figure 4.2.1B). This could indicate either that the drain levels are not located at similar depths below the terrain or that the drains, situated in the downstream area of the field, cannot prevent groundwater build-up from exceeding the drain depth. The simulated groundwater levels were consistent with the measured groundwater levels at P3. Though the simulated drainage events were consistent with measured drainage, there were some instances, where the model did not capture the measured drainage events. E.g., around October 2021, a large event > 20 mm/d was not captured by the model (Figure 4.3.1C). Still, there was a pattern of simulated drainage being overestimated (Figure 4.3.1C and Table 4.3.1).

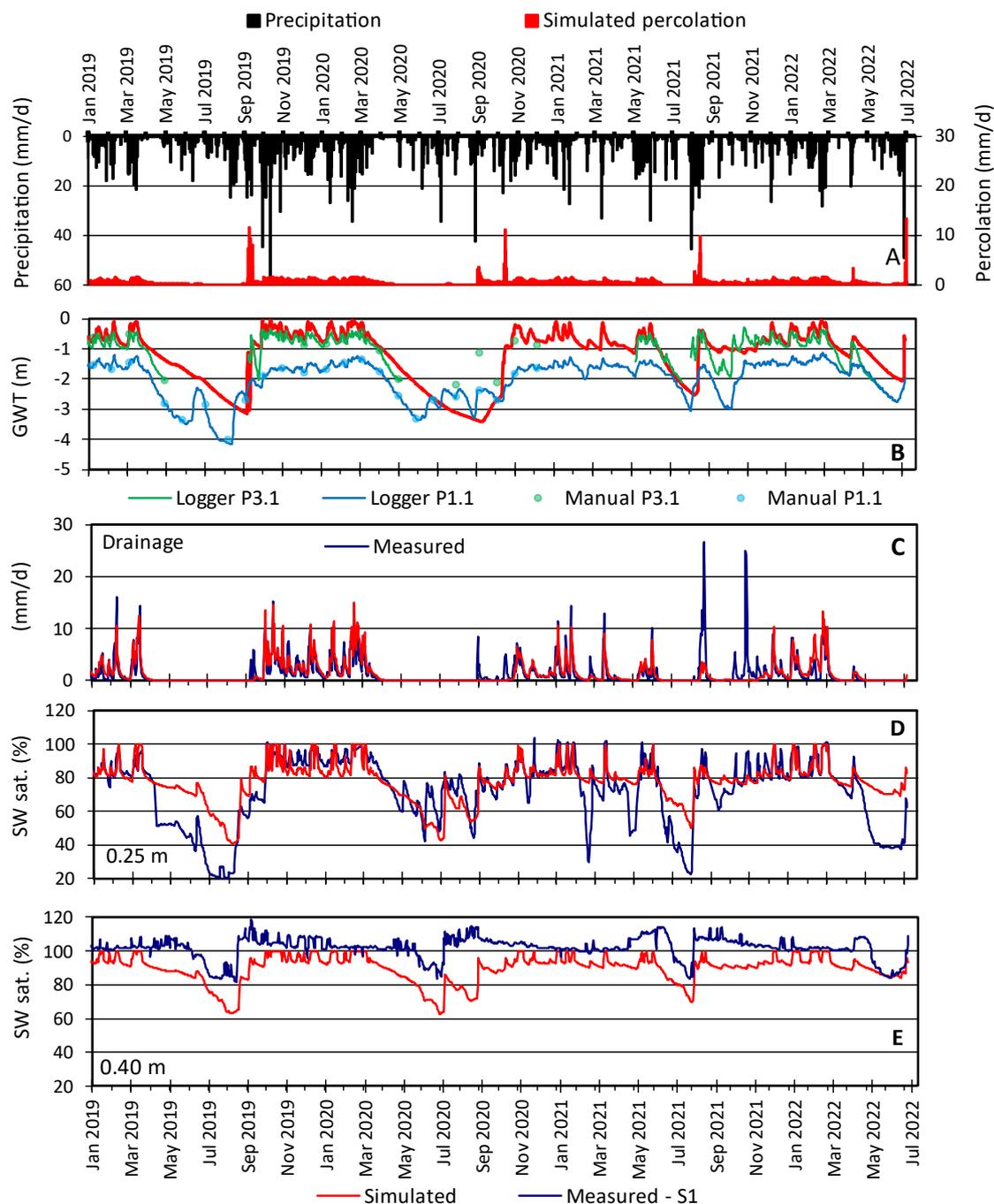


Figure 4.3.1. Soil water dynamics at Estrup: Measured precipitation and simulated percolation 1 mbgs (A); simulated and measured groundwater table, GWT (B); simulated and measured drainage (C); and simulated and measured soil saturation (SW sat.) at two different soil depths (D and E). The measured data in B comprises piezometers located in the buffer zone. The measured data in D and E are from TDR probes installed at S1 (Figure 2.3.1). The dashed vertical line indicates the calibration period to June 2004.

At Estrup, only TDRs in S1 were functional during this reporting period. The deduced soil water saturation in 0.25 mbgs seemed to coincide with the drainage, so the maximum soil water saturation was measured during periods of drainage (Figures 4.3.1C and D). At 0.4 mbgs, the coincidence between maximum soil water saturation and drainage was also observed (Figures 4.3.1C and E), though not as evident as in 0.25 mbgs. Deduced soil water saturation exceeding 100% in 0.4 mbgs was related to the applied porosity in the saturation calculation, which was similar to what was used in the model for the given depths of measured

soil water content. Nevertheless, the soil water saturation of around 100% was consistent with measurements at P3.1 showing groundwater levels fluctuating around 0.5 mbgs during drainage. Generally, the simulated soil water saturation, captured the dynamics of the measurements, although simulated values were offset from measured values.

Table 4.3.1. Annual water balance for Estrup (mm yr<sup>-1</sup>).

	Normal Precipitation <sup>2</sup>	Precipitation <sup>3)</sup>	Actual evapo- transpiration <sup>4</sup>	Measured drainage	Simulated drainage	Groundwater recharge1 <sup>5</sup>	Groundwater recharge2 <sup>6</sup>
01.07.99–30.06.00 <sup>1)</sup>	968	1173	466	-	539	168	168
01.07.00–30.06.01	968	887	420	356	336	111	131
01.07.01–30.06.02	968	1290	516	505	556	270	219
01.07.02–30.06.03	968	939	466	329	346	144	126
01.07.03–30.06.04	968	928	502	298	312	128	115
01.07.04–30.06.05	968	1087	476	525	466	86	146
01.07.05–30.06.06	968	897	460	258	339	179	98
01.07.06–30.06.07	968	1370	510	547	616	312	244
01.07.07–30.06.08	968	1047	536	521	564	-9	-53
01.07.08–30.06.09	968	1065	476	523	323	66	266
01.07.09–30.06.10	968	1190	528	499	510	163	151
01.07.10–30.06.11	968	1158	546	210	342	402	270
01.07.11–30.06.12	968	1222	469	479	504	274	249
01.07.12–30.06.13	968	1093	452	503	482	138	159
01.07.13–30.06.14	968	1015	571	404	434	39	9
01.07.14–30.06.15	968	1190	439	379	490	373	262
01.07.15–30.06.16	968	1230	446	491	564	293	220
01.07.16–30.06.17	968	847	511	274	264	63	72
01.07.17–30.06.18	968	1098	544	546	544	8	10
01.07.18–30.06.19	968	918	404	284	300	230	214
01.07.19–30.06.20	968	1396	509	620	713	267	174
01.07.20–30.06.21	968	1064	465	399	401	200	197
01.07.21–30.06.22	968	1044	417	522	406	105	221
Average	968	1093	484	431	450	174	160

<sup>1)</sup> The monitoring regarding water sampling started in April 2000. <sup>2)</sup> Normal values based on time series for 1961–1990 corrected to the soil surface (Olesen, 1991). <sup>3)</sup> Precipitation is corrected to the soil surface according to the method of Allerup and Madsen (1979). <sup>4)</sup> Actual evapotranspiration is estimated by the MACRO-model applying climate data including potential evapotranspiration. <sup>5)</sup> Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-measured drainage. <sup>6)</sup> Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-simulated drainage.

The estimated yearly water balance for Estrup is shown in Table 4.3.1. The measured precipitation in 2021 and 2022 were 3% and 5% lower compared to the average. The simulated actual evapotranspiration was lower than the average by 4% and 14% for 2021 and 2022. The measured drainage was 7% lower than the average in 2021 and 21% larger than the average in 2022. The simulated drainage was 11% and 10% lower in 2021 and 2022 compared to the average. It is noted that the groundwater recharge estimates are modified to include two different methods rather than one. The recharge estimate method used hitherto was the following:

$$\text{Groundwater recharge1} = \text{precipitation} - \text{simulated actual evapotranspiration} - \text{measured drainage},$$

and the currently added is:

$$\text{Groundwater recharge2} = \text{precipitation} - \text{simulated actual evapotranspiration} - \text{simulated drainage}.$$

The added recharge estimate represents the simulated groundwater recharge while the previous method yields a groundwater recharge estimate based on a mix of simulated and measured data. The estimated groundwater recharge with the recharge1 method for 2021 increased by 21% compared to the average while the estimated groundwater recharge for 2022 was 40% lower than the average. With the recharge2 method, the estimated groundwater recharge for 2021 and 2022 increased by 24% and 39% compared to the average. In terms of absolute values, the difference in estimated recharge using the two estimation methodologies yielded a difference in a yearly average of 14 mm/yr. Hence, the recharge estimated from the simulated results (recharge2 method) was 8% lower compared to the groundwater recharge estimated from the recharge1 method (Table 4.3.1).

#### 4.4 Faardrup

The measured groundwater levels from various intakes show that levels were at their maximum during periods of drainage (Figures 4.4.1B and C) but not as distinctly as observed in Silstrup and Estrup. At Faardrup, the logger measurements from P2.2 and M6.4 were offset up to 2 m during periods of declining groundwater levels. The measured levels in M6.4 were generally more surface-near relative to P2.2 and likely related to the terrain sloping downwards from P2 at around 32 masl towards M6 at around 30 masl. Hence, the measured groundwater levels were consistent with the general groundwater flow from the upstream well, P2 to the downstream well, M6 (Figure 2.4.1, Chapter 2, Faardrup). However, the measurements showed that there was a temporal lag between P2.2 and M6.4 such that the peaks/lows in groundwater levels were not coincident. For instance, from around January-March 2021 and December 2021-March 2022, groundwater peaks/lows in M6.4 were reached later compared to P2.2 (Figure 4.4.1B). This indicates that the hydraulic properties surrounding the two wells are different and, thus also their response to groundwater level fluctuations. The simulated groundwater captured the overall observed dynamics, although offset compared to both the logger measurements.

At both Silstrup and Estrup, it was observed that elevated groundwater levels remained relatively constant during drainage. At Faardrup, where groundwater levels were also elevated during drainage, it is noted that groundwater levels seemed less responsive to drainage (Figure 4.4.1B and C). That is, after a low in groundwater level, the increase following a drainage event was relatively gentle compared to both Silstrup and Estrup, where increases in groundwater level following a drainage event was essentially instantaneous and more pronounced. The reason for the slower response to drainage events is likely related to the greater depth to the groundwater at Faardrup compared to Silstrup and Estrup. At Faardrup, the maximum depth to the groundwater was around 6 m, while it was around 3 and 4 m at Silstrup and Estrup. Consequently, groundwater levels at Faardrup must increase more to reach the drain depth. This effect is also seen in the average drainage, which at Faardrup is substantially lower (84 mm/yr) compared to Silstrup (219 mm/yr) and Estrup (431 mm/yr).

Due to errors in the programme of the new data logger installed at Faardrup on October 25, 2019, TDR-data were erroneous and the old logger was uninstalled on October 22, 2019. The short period of deduced soil water saturation showed that relatively large changes (up to around 50%) in saturation occurred in periods with and without drainage in all three depths ranging from 0.25 to 1.1 mbgs (Figure 4.4.1D-F). This is in line with groundwater levels being relatively low at Faardrup compared to the other clay till fields. The simulated soil water saturation captured the dynamics of the observations, although offset. Also, with increasing depth, the simulated soil water saturation is overestimated in periods with low groundwater levels.

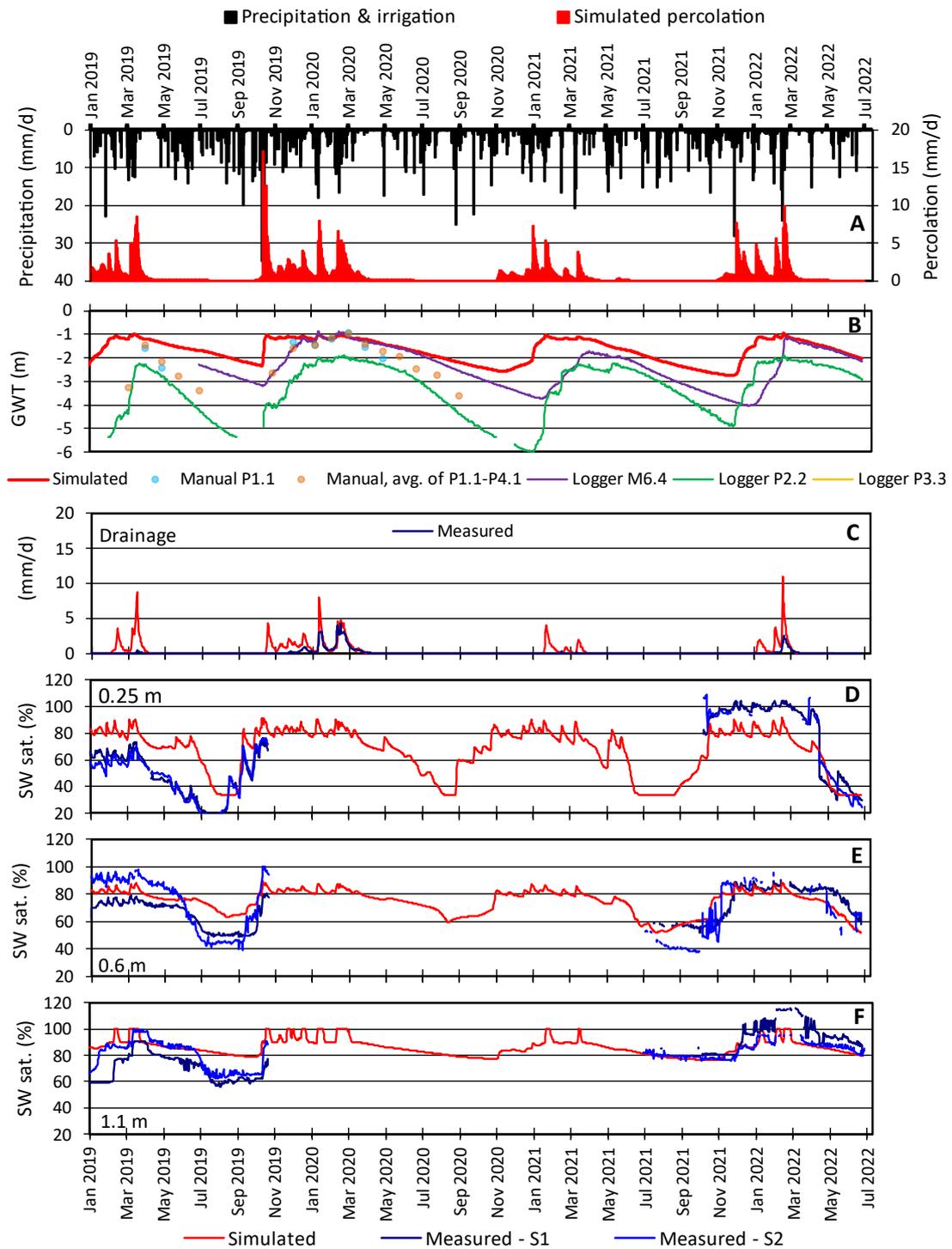


Figure 4.4.1. Soil water dynamics at Faardrup. Measured precipitation and simulated percolation 1 mbgs (A); simulated and measured groundwater table in m above the soil surface, GWT (B); simulated and measured drainage (C); and simulated and measured soil water saturation (SW sat.) at three different soil depths (D, E, and F). The measured data in B derives from piezometers located in the buffer zone. The measured data in D, E, and F derive from TDR probes installed at S1 and S2 (Figure 2.4.1). No water saturation measurements from 23 October 2019 to 30 June 2021.

The estimated yearly water balance for Faadруп is shown in Table 4.4.1. The measured precipitation in 2021 and 2022 were 10% and 7% lower compared to the average. The simulated actual evaporation was larger than the average by 8% in 2021 and 6% lower than the average in 2022. The measured drainage was 95 and 62% lower than the average in 2021 and 2022. The simulated drainage in 2021 was 46% lower compared to the average and 2% larger than the average in 2022. It is noted that the groundwater recharge estimates are modified to include two different methods rather than one. The recharge estimate method used hitherto was the following:

*Groundwater recharge1 = precipitation – simulated actual evapotranspiration – measured drainage,*

and the currently added is:

*Groundwater recharge2 = precipitation – simulated actual evapotranspiration – simulated drainage.*

The added recharge estimate represents the simulated groundwater recharge while the previous method yields a groundwater recharge estimate based on a mix of simulated and measured data. The estimated groundwater recharge with the recharge1 method for 2021 decreased by 14% compared to the average while the estimated groundwater recharge for 2022 was 22% larger than the average. With the recharge2 method, the estimated groundwater recharge for 2021 and 2022 decreased by 41% and 18% compared to the average. In terms of absolute values, the difference in estimated recharge using the two estimation methodologies yielded a difference in a yearly average of 24 mm/yr. Hence, the recharge estimated from the simulated results (recharge2 method) was 17% lower compared to the groundwater recharge estimated from the recharge1 method (Table 4.4.1).

Table 4.4.1. Annual water balance for Faardrup (mm/yr).

	Normal Precipitation <sup>1</sup>	Precipitation <sup>2</sup>	Actual Evapotranspiration <sup>3</sup>	Measured drainage	Simulated drainage	Groundwater recharge1 <sup>4</sup>	Groundwater recharge2 <sup>5</sup>
01.07.99–30.06.00	626	715	572	192	151	-50	-9
01.07.00–30.06.01	626	639	383	50	35	206	221
01.07.01–30.06.02	626	810	469	197	201	145	141
01.07.02–30.06.03	626	636	470	49	108	118	59
01.07.03–30.06.04	626	685	513	36	24	136	148
01.07.04–30.06.05	626	671	469	131	55	72	147
01.07.05–30.06.06	626	557	386	28	18	144	154
01.07.06–30.06.07	626	796	511	202	191	83	94
01.07.07–30.06.08	626	645	522	111	76	12	47
01.07.08–30.06.09	626	713	472	46	19	195	221
01.07.09–30.06.10	626	624	438	54	35	132	152
01.07.10–30.06.11	626	703	472	133	144	97	86
01.07.11–30.06.12	626	746	430	98	112	218	203
01.07.12–30.06.13	626	569	450	62	69	57	50
01.07.13–30.06.14	626	595	438	44	92	112	64
01.07.14–30.06.15	626	819	493	123	167	202	159
01.07.15–30.06.16	626	800	429	124	167	247	204
01.07.16–30.06.17	626	628	410	0	34	218	184
01.07.17–30.06.18	626	754	426	169	265	160	63
01.07.18–30.06.19	626	668	426	5	104	237	137
01.07.19–30.06.20	626	745	385	33	242	327	118
01.07.20–30.06.21	626	621	491	4	58	126	72
01.07.21–30.06.22	626	641	430	32	110	179	101
Average	626	686	456	84	108	147	122

<sup>1</sup>) Normal values based on time series for 1961–1990 corrected to the soil surface (Olesen, 1991). <sup>2</sup>) For July 1999–June 2002, July 2003–June 2004, in January and February of both 2005 and 2006, and July 2006–June 2007, measured at the DIAS Flakkebjerg meteorological station located 3 km from the field (see detailed text above). Precipitation is corrected to the soil surface according to the method of Allerup and Madsen (1979). <sup>3</sup>) Actual evapotranspiration is estimated by the MACRO-model applying climate data including potential evapotranspiration <sup>4</sup>) Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-measured drainage. <sup>5</sup>)Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-simulated drainage.

## 4.5 Lund

The measured groundwater levels from various intakes showed a relatively large offset between the measurements (Figure 4.5.1B). All shown wells, except P2.3, are downstream wells located at a terrain level around 7 masl and when comparing P1.2, P4.2, and M5.4, the measurements were clearly offset. Of these wells, M5.4 and P1.1 with intakes around 6-6.5 mbgs, showed comparable groundwater dynamics both in terms of time and magnitude, whereas P4.2 differed substantially. P4.2 is screened around 8.5 mbgs and did not exhibit large fluctuations (around 1 m) compared to P4.2 and M5.4 (around 2 m). It is noted that all three downstream wells showed offsets in measured groundwater levels, also when screened at the same elevation. This indicates that the hydraulic properties of the soil matrix surrounding the different screens are heterogeneous. Despite the offset between the groundwater level measurements within the different intakes, the overall groundwater flow was from the upstream well P2.3 located around 10 masl towards the downstream wells P1.2, P4.2, and M5.4 located around 7 masl. Nevertheless, comprehensive monitoring of several intakes at the Lund field is ongoing to better understand their hydraulic connectivity to the groundwater system and to make a rigorous analysis of the hydraulic head distribution and thus the groundwater flow pattern at the field.

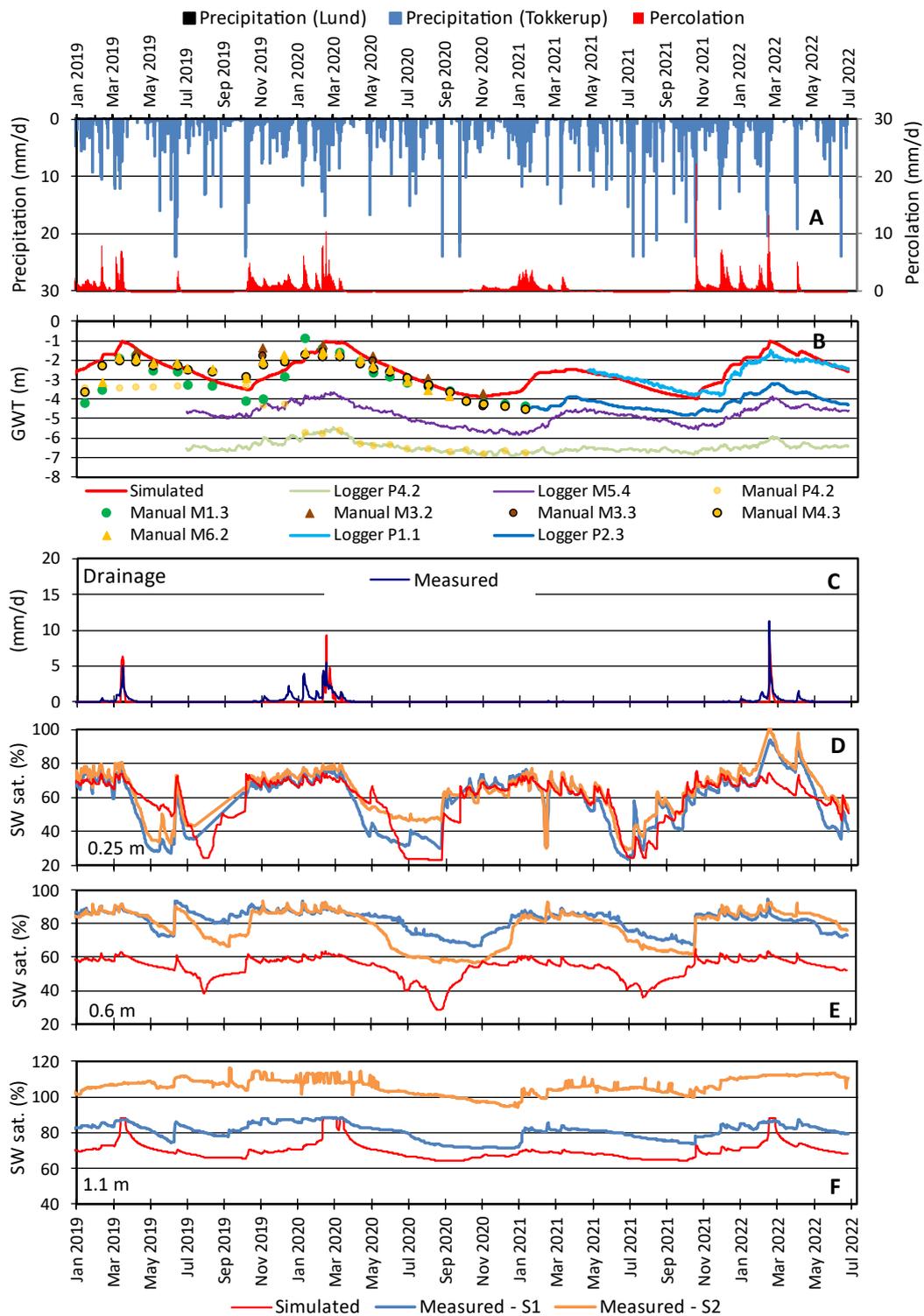


Figure 4.5.1. Soil water dynamics at Lund: Measured precipitation and simulated percolation 1 mbgs (A); simulated and measured groundwater table in m above the soil surface, GWT (B); simulated and measured soil drainage (C); and simulated and measured soil saturation (SW sat.) at three different soil depths (D, E, and F). The measured data in B derives from piezometers (P) and wells (M) located in the buffer zone. The measured data in D, E, and F were derived from TDR probes installed at S1 and S2 (Figure 2.5.1).

The estimated yearly water balance for Lund is shown in Table 4.5.1. The measured precipitation in 2021 was 12% lower compared to the average and 18% larger than the average in 2022. The simulated actual evaporation was larger than the average by 1% and 2% in 2021 and 2022. The measured drainage in 2021

was 99% lower than the average and 13% larger than the average in 2022. The simulated drainage in 2021 was 100% lower compared to the average and 10% larger than the average in 2022. It is noted that the groundwater recharge estimates are modified to include two different methods rather than one. The recharge estimate method used hitherto was the following:

$$\text{Groundwater recharge1} = \text{precipitation} - \text{simulated actual evapotranspiration} - \text{measured drainage},$$

and the currently added is:

$$\text{Groundwater recharge2} = \text{precipitation} - \text{simulated actual evapotranspiration} - \text{simulated drainage}.$$

The added recharge estimate represents the simulated groundwater recharge while the previous method yields a groundwater recharge estimate based on a mix of simulated and measured data. The estimated groundwater recharge with the recharge1 method for 2021 decreased by 32% compared to the average while the estimated groundwater recharge for 2022 was 148% larger than the average. With the recharge2 method, the estimated groundwater recharge for 2021 decreased by 53% compared to the average and increased by 107% in 2022 compared to the average. It is noted that average values are based on relatively few years of measurements and may likely change substantially as monitoring continues, and thus, it is expected that the deviations from average values will decrease. In terms of absolute values, the difference in estimated recharge using the two estimation methodologies yielded a difference in a yearly average of 29 mm/yr. Hence, the recharge estimated from the simulated results (recharge2 method) was 46% larger compared to the groundwater recharge estimated from the recharge1 method (Table 4.5.1).

Table 4.5.1. Annual water balance for Lund (mm/yr). Precipitation data from the nearby precipitation gauge at Tokkerup for the period July 2018 – July 2022.

	Normal Precipitation <sup>1</sup>	Precipitation <sup>2</sup>	Actual Evapotransp. <sup>3</sup>	Measured drainage	Simulated drainage	Groundwater recharge1 <sup>4</sup>	Groundwater recharge2 <sup>5</sup>
01.07.2018–30.06.2019	577	602	466	38	29	98	106
01.07.2019–30.06.2020	577	588	501	131	57	-44	30
01.07.2020–30.06.2021	577	541	497	1	0	43	44
01.07.2021–30.06.2022	577	725	498	67	32	159	194
Average	577	614	491	59	30	64	94

<sup>1</sup>) Normal values based on time series for 1961–1990 (Scharling, 2000). <sup>2</sup>) Precipitation is corrected to the soil surface according to the method of Allerup and Madsen (1979). <sup>3</sup>) Actual evapotranspiration is estimated by the MACRO-model applying climate data including potential evapotranspiration <sup>4</sup>)Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-measured drainage. <sup>5</sup>)Groundwater recharge calculated as precipitation-simulated actual evapotranspiration-simulated drainage.



## 5. Bromide tracer test

This chapter describes the bromide tests done in the five fields, Jynde vad, Silstrup, Estrup, Faardrup, and Lund. No new data or interpretations are added since the previous report (Badawi *et al.* 2022), where the bromide leaching results from all fields were revisited and analysed to improve the fundamental understanding of the hydrogeology in the fields. As the bromide leaching plots are used in the evaluation of the present pesticide tests, the chapter has been included for convenience.

In the analysis of the bromide results, the time until the maximum concentration of bromide reaches the different depths of water sampling was used to estimate transport times from the surface to the specific filter of interest and allow for comparison between depths. The time of maximum concentration was used in conjunction with the general pattern of breakthrough curves when possible. However, since the number of collected samples differed among the monitored well screens, continuous breakthrough curves were not equally available for all screens. Therefore, the time of maximum concentration was used to achieve transport time ranges within each monitoring depth regardless of the number of samples collected. These transport times are not to be conflated with average transport times. The average transport time (mean breakthrough time) represents when half of the applied mass has passed through the location of measurement which may not necessarily coincide with the breakthrough of maximum concentration. Consequently, bromide detections are generally occurring both before and after the time of the reported maximum concentration breakthroughs.

### 5.1 Bromide leaching at Jynde vad

At Jynde vad, bromide was applied three times (November 1999, March 2003, and May 2012) as 30 kg/ha potassium bromide.

In the suction cups located 1 mbgs, the maximum bromide concentrations after November 1999, March 2003, and May 2012 application are measured within 1-2, 7, and 3-4 months, respectively (Figure 5.1.1).

In the suction cups located 2 mbgs, the maximum bromide concentrations after November 1999, March 2003, and May 2012 applications are measured within 2-3, 8-11, and 4-11 months, respectively (Figure 5.1.1).

The maximum bromide concentrations generally reach the suction cup depth of 1 mbgs slower after the March 2003 application compared to the other applications. A similar pattern is seen at the Tylstrup field, and the reason is likely related to different precipitation and temperature conditions in 2003, resulting in different soil water conditions. That is, bromide transport is dependent on soil saturation, and for instance, with higher temperatures, more evaporation could lead to less soil saturation. In contrast, increased precipitation could lead to more soil saturation. Overall, the transport time for the maximum bromide concentration to 1 and 2 mbgs in the variably saturated zone is around 4 and 7 months, respectively.

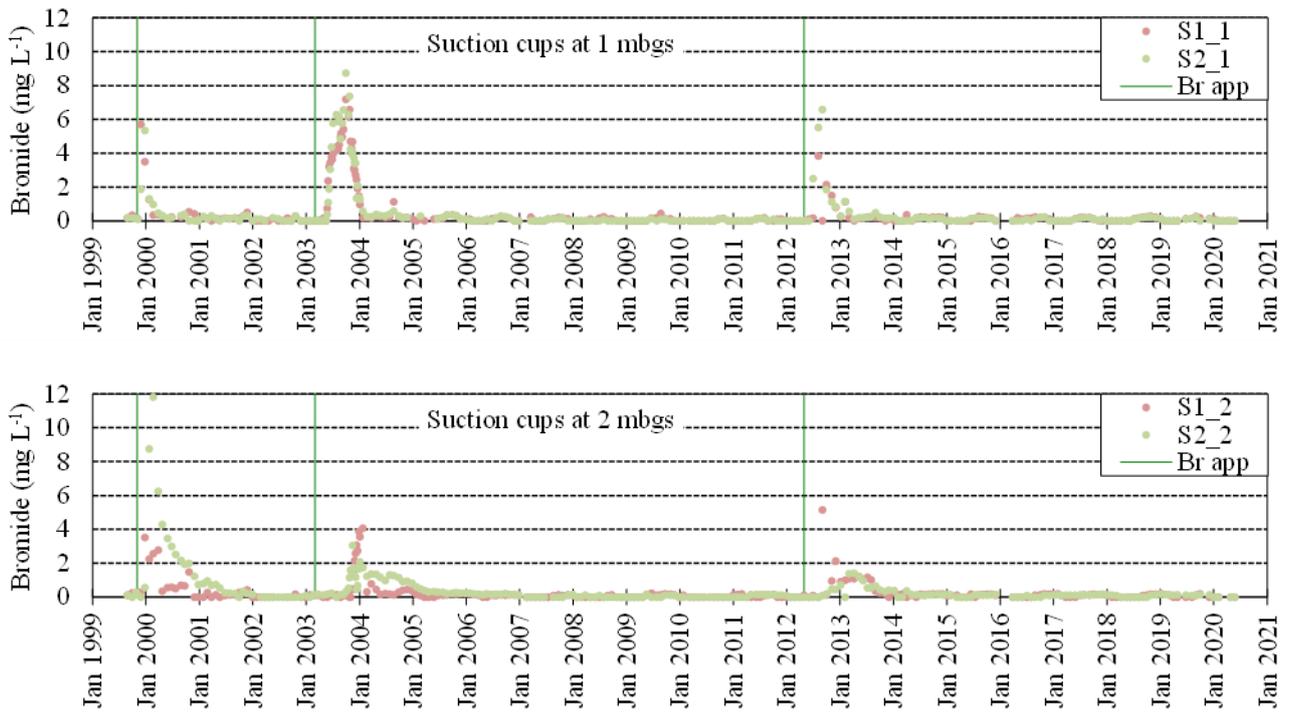


Figure 5.1.1. Measured bromide concentration in the variably saturated zone at Jynde vad.

For the groundwater samples, the current analysis is constricted to the monitoring wells; M1, M2, M3, M4, and H1 in the depth interval from around 2.5 to 4.5 mbgs (Figure 5.1.2). Sampling is conducted from ~1.5 mbgs in these wells also, but as measured concentrations are generally close to the detection limit or below (not shown but included in previous PLAP reports, e.g., Rosenbom *et al.*, 2021) the results are not included in the analysis. The measured bromide concentrations in the remaining monitoring wells, M5, M6, and M7 are generally less than 1 mg/L in all depths (not shown but included in previous PLAP reports, e.g., Rosenbom *et al.*, 2021). M7 is regarded as an upstream well and as bromide is measured in M7, further analysis of the flow field is needed to fully understand the groundwater flow dynamics across the field. Such analyses are under preparation for all the fields. However, for the sake of simplicity, in the present analysis, M5, M6, and M7 are not assumed to be part of the flow field represented by the remaining wells.

In the groundwater samples from ~2.5 mbgs, the maximum bromide concentrations after November 1999, March 2003, and May 2012 applications are measured within 10-11, 13-19, and 5-16 months (Figure 5.1.2).

In the groundwater samples from ~3.5 mbgs, the maximum bromide concentrations after November 1999, March 2003, and May 2012 applications are measured within 11-25, 13-25, and 14-19 months (Figure 5.1.2).

In the groundwater samples from ~4.5 mbgs, the maximum bromide concentrations after November 1999, March 2003, and May 2012 applications are measured within 18-32, 5-29, and 37-87 months (Figure 5.1.2).

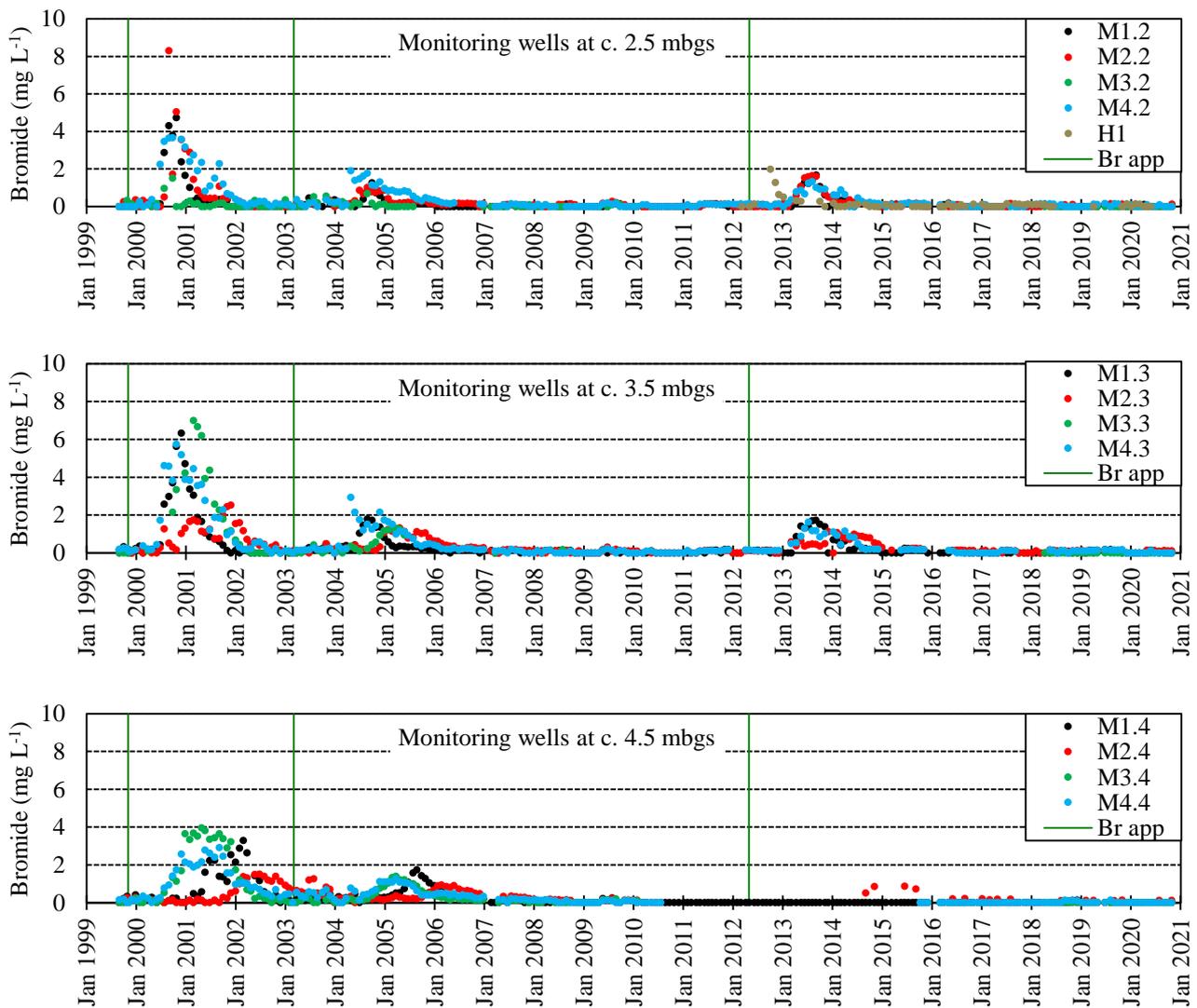


Figure 5.1.2. Measured bromide concentration in the groundwater at Jyndeavad.

For a specific depth, the average breakthrough time for the maximum bromide concentration is calculated from the breakthrough time of the maximum concentration within each of the wells representing that particular depth. Thus, for the November 1999, March 2003, and May 2012 applications, the average time for maximum bromide concentrations reaching the screens at around 2.5, 3.5, and 4.5 mbgs are 14, 18, and 35 months, respectively. For the screens in ~4.5 mbgs, it is noted that the interval of 37-87 months in which the breakthrough of maximum concentrations is observed after the May 2012 application is relatively large compared to the intervals of maximum concentration breakthrough from the other applications. The relatively large interval in which maximum concentrations are observed after the May 2012 application is mainly due to lack of bromide detections in M3 and M4 up to four years after the application (Figure 5.1.2). The maximum concentrations do not exceed 0.14 mg/L in M1 and M4, and the concentrations are substantially lower compared to the maximum concentration of 0.87 mg/L measured after 37 months in M2. If the maximum concentrations from M1 and M4 after the May 2012 application are omitted in calculating the average time for maximum bromide concentrations reaching ~4.5 mbgs, the average time is changed from 35 months to 24 months.

Overall, the average breakthrough time of measured maximum concentrations within the different depths and locations coincides with the general breakthrough patterns. At ~2.5-3.5 mbgs, bromide pulses generally show breakthrough 0.5-1.5 years after application and at ~4.5 mbgs, the time of breakthrough is generally 1-2 years after application (Figure 5.1.2). For all the sampled depths, it is noted that bromide concentrations above the detection limit are measured before and after the transport times representing maximum concentrations.

## 5.2 Bromide leaching at Silstrup

At Silstrup, bromide was applied three times (May 2000, April 2009, and September 2012) as 30.0, 31.5, and 30.5 kg/ha potassium bromide, respectively.

In the suction cups, samples were only collected with the May 2000 and September 2012 applications. In the suction cups located 1 mbgs, the maximum bromide concentrations after May 2000 and September 2012 applications are observed within 5-9 and 2-5 months (Figure 5.2.1). For both applications, it is noted that concentrations are observed immediately after application and that bromide pulses extend up to several years.

In the suction cups located 2 mbgs, the maximum bromide concentrations after May 2000 and September 2012 applications are measured within 39-47 and 4-15 months (Figure 5.2.1). Again, for both applications, it is noted that concentrations are observed immediately after application and that bromide pulses extend up to several years.

The average breakthrough time for maximum concentration observations in the suction cups at 1 mbgs is overall five months after application. Although the maximum concentration is measured within five months of the May 2000 application in both suction cups, it is evident that another pulse of bromide is measured after around four years (Figure 5.2.1). In the suction cups at 2 mbgs, the average time for the maximum concentration breakthrough is much longer around 26 months (Figure 5.2.1). The reason for the overall longer transport times of maximum concentrations at around 2 mbgs is related to a pattern of wider bromide pulses. In fact, the maximum concentration measured at ~2 mbgs after the May 2000 application coincides with the second breakthrough (in January 2004) of bromide at ~1 mbgs. However, though the maximum concentrations are observed quite long after application, it is clear that increased bromide concentrations are occurring immediately after application (Figure 5.2.1). The results from the suction cups at around 1 mbgs with a bimodal bromide breakthrough pattern together with relatively wide bromide pulses reaching ~2 mbgs contrast with what was observed in the variably saturated zone of the sandy fields. At the sandy field Jyndevad, the bromide pulses in the variably saturated zone are relatively narrow and patterns of bimodal bromide breakthrough are not observed (Figure 5.1.1). The Silstrup field is characterized as a clay-till field, and the observed pattern in bromide breakthrough in the variably saturated zone indicates that flow and transport pathways are more heterogeneous compared to the sandy fields.

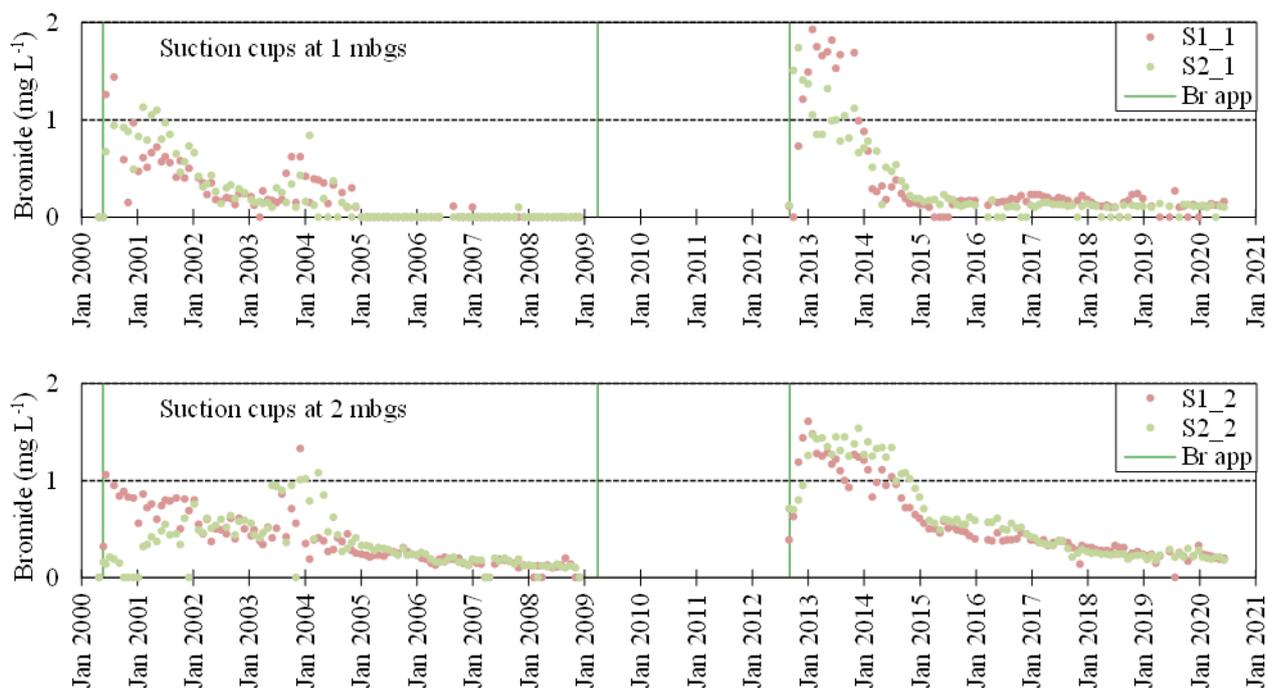


Figure 5.2.1. Measured bromide concentration at Silstrup.

The samples representing drainage from around 1 mbgs are collected in a drain well collecting drainage from the entire field (Figure 5.2.2). Therefore, there are no time ranges reported for the drainage samples, and the maximum concentrations in the drainage after May 2000, April 2009, and September 2012 applications are measured after 43, 7, and 3 months, respectively (Figure 5.2.2). However, it is noted that increased bromide concentrations were detected in drainage samples already in the first event after each application. Though the breakthrough of maximum concentrations varies considerably in this field, it is evident that a fraction of the applied bromide is transported fast to the drains.

Similar to the bimodal breakthrough of bromide in suction cups at around 1 mbgs, the bromide concentrations in drainage samples after the May 2000 application also show a pattern resembling bimodal behavior (Figure 5.2.2). As such, maximum concentrations around 1.5 mg/L are measured around January 2002 as well as January 2004, which also represented the time of the maximum concentration in suction cups (Figure 5.2.1). Generally, it is noted that the maximum bromide concentrations are measured after the first drainage event following an application. Although the maximum concentrations are measured relatively fast in drainage samples after bromide applications, detections of bromide are continuous throughout all monitoring periods.

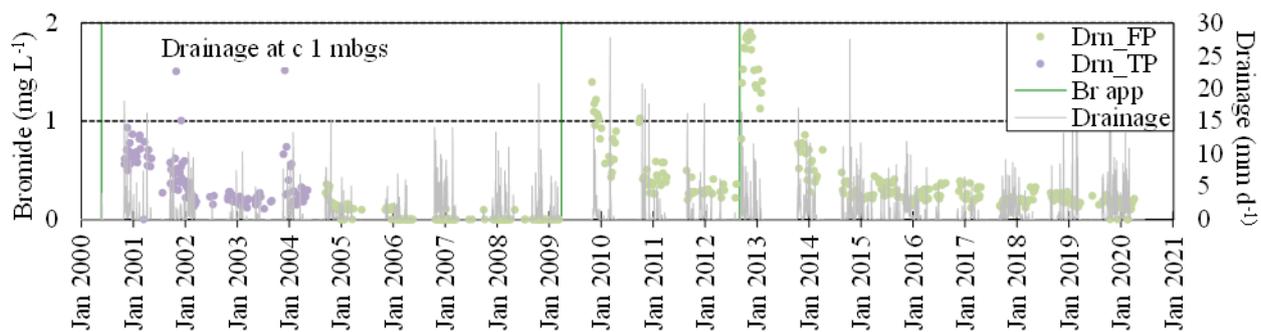


Figure 5.2.2. Measured bromide concentration in drainage at Silstrup. The suffix FP and TP refer to flow- and time-proportional sampling, respectively, which are described in Kjær et al. (2004) and Appendix 2.

M12 is regarded as an upstream well. However, as bromide is measured in M12, although in low concentration (generally < 0.5 mg/L) further analysis of the flow field is needed to fully understand the groundwater flow dynamics across the field. Such analyses are under preparation for all the fields. However, for the sake of simplicity, in the present analysis, M12 is assumed not to be part of the flow field represented by the remaining wells. Further, at ~5 mbgs, only sampling in a single well, M5 is performed after the application in September 2012.

In the groundwater samples from ~2 mbgs, the maximum bromide concentrations after May 2000, April 2009, and September 2012 applications are measured within 1-44, 5-25, and 3 months (Figure 5.2.3).

In the groundwater samples from ~3 mbgs, the maximum bromide concentrations after May 2000, April 2009, and September 2012 applications are measured within 10-46, 2-29, and 2-18 months (Figure 5.2.3).

In the groundwater samples from ~4 mbgs, the maximum bromide concentrations after May 2000, April 2009, and September 2012 applications are measured within 16-45, 1-13, and 15-36 months (Figure 5.2.3).

In the groundwater samples from ~5 mbgs, the maximum bromide concentrations after May 2000, April 2009, and September 2012 applications are measured within 10-50, 4-23, and 16 months (Figure 5.2.3).

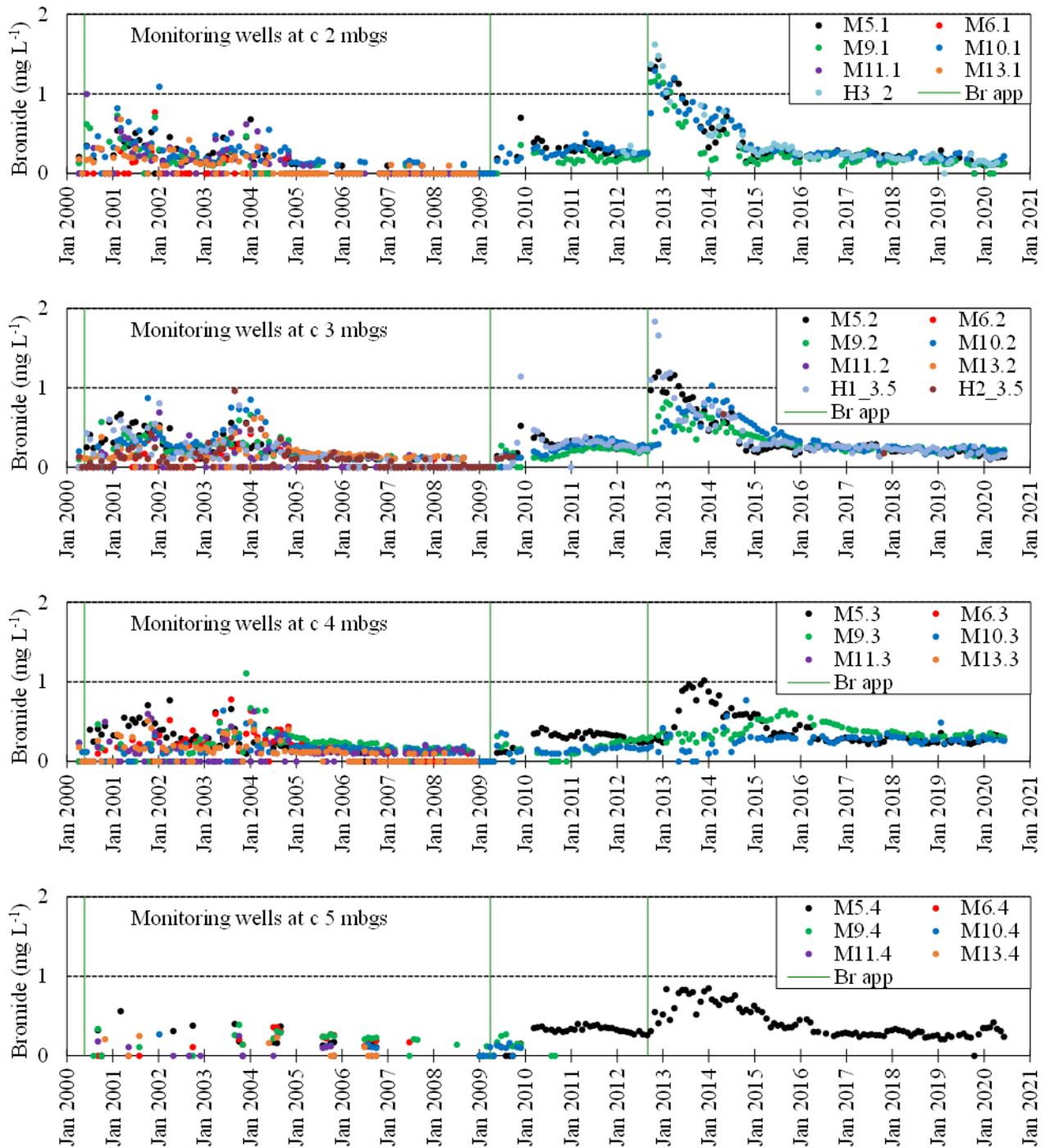


Figure 5.2.3. Measured bromide concentration in the groundwater at Silstrup.

For a specific depth, the average breakthrough time for the maximum bromide concentration is calculated from the time of measured maximum concentration within each of the wells representing that particular depth. Hence, for the May 2000, April 2009, and September 2012 applications, the average time for maximum bromide concentrations reaching depths at around 2, 3, 4, and 5 mbgs are 11, 18, 23, and 23 months, respectively. Although there is a general pattern of longer transport times before reaching maximum concentrations with increasing depths, the intervals in which the maximum concentrations are

measured within the different screens have a relatively large range. For instance, at ~2 mbgs and ~4 mbgs, the maximum concentrations are measured within 1-44 months for the May 2000 application and 15-36 months for the September 2012 application. From the general pattern of bromide pulses at ~2-3 mbgs, it seems that two breakthroughs are occurring after the May 2000 application: one immediately after and another around three years after application (Figure 5.2.3). These are likely related to heavy precipitation events enabling fast flow and solute transport. Following the April 2009 application, the bromide pulses are occurring within half a year in all depths. After the September 2012 application, bromide pulses are detected immediately at ~2 mbgs and seem to move further down to ~5 mbgs within 1-1.5 years in M5 while the transport to deeper levels in other wells is less evident.

The intervals in which maximum bromide concentrations are measured at the different depths are specified above and show that maximum bromide concentrations are measured up to around four years after applications depending on the well location. The variation in the time of measured maximum concentrations in the variably saturated zone, drainage, and groundwater samples also indicate that flow and transport of solutes are affected by heterogeneity. It is noted that the breakthrough of maximum concentrations also occurs relatively fast within a few months after application, e.g., at ~2 mbgs, the maximum concentrations are measured within one and three months after the May 2000, and September 2012 applications, respectively (Figure 5.2.3). Similarly, around 3 and 4 mbgs, maximum concentrations are measured within 2 months after April 2009 and September applications (Figure 5.2.3). A similar pattern was also seen from the occurrences of bromide pulses in the various depths. These fast occurrences of maximum concentrations or bromide pulses, in general, are not observed at the sandy fields, and with well-known development of preferential flows at the clay-till fields (Lindhardt *et al.*, 2001), the fast maximum breakthroughs are likely caused by preferential transport of solutes. Additionally, the observed fast breakthrough of maximum bromide concentrations in drainage samples within three months of the September 2012 application may be due to preferential flows (Figure 5.2.2).

Overall, the majority of the maximum bromide concentrations reach the screens at ~2-5 mbgs within 1-2 years after application, but maximum concentration levels are measured up to four years after application. For all the sampled depths, it is noted that increased bromide concentrations above the detection limit are measured before and after the transport times representing maximum concentrations.

### **5.3 Bromide leaching at Estrup**

At Estrup, bromide was applied four times (May 2000, November 2005, April 2009, and September 2012) as 30 kg/ha potassium bromide.

In the suction cups, samples were only collected with the May 2000, November 2005, and September 2012 applications. In the suction cups located 1 mbgs, the maximum bromide concentrations after May 2000, November 2005, and September 2012 applications are measured within 2, 3-6, and 4-14 months (Figure 5.3.1). For all applications, it is noted that increased concentrations are observed more or less immediately after application and that bromide pulses extend up to several years.

In the suction cups located 2 mbgs, the maximum bromide concentrations after May 2000, November 2005, and September 2012 applications are measured within 43-44, 6-13, and 14-19 months, respectively (Figure 5.3.1). Again, it is noted that concentrations are observed shortly after application and that bromide pulses extend up to several years.

In general, at 1 mbgs, the maximum concentrations are measured six months after application. At 2 mbgs, the average breakthrough time for the maximum concentration is much longer, around 23 months (Figure

5.3.1). The patterns of wide bromide pulses and immediate occurrence of increased bromide concentrations just after application in the variably saturated zone are similar to what is observed at Silstrup. As such both Silstrup and Estrup are characterized as clay-till fields and the low permeable properties of the sediment matrix are likely causing the relatively slow passing of maximum bromide pulses (and the wider pulses) as well as fast occurrence of increased concentrations related to preferential flows.

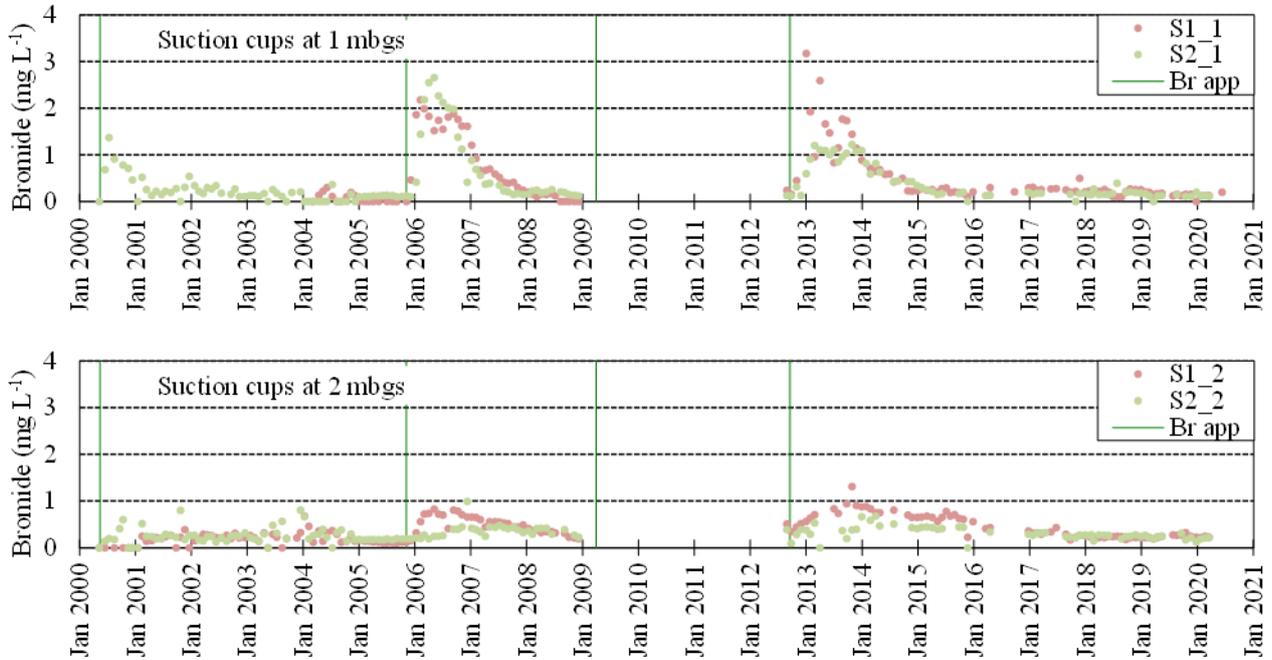


Figure 5.3.1. Measured bromide concentration at Estrup.

The samples representing drainage from around 1 mbgs are collected in a drain well collecting drainage from the entire field (Figure 5.3.2). Therefore, no ranges are reported for the drainage samples. The maximum concentrations in the drainage after May 2000, November 2005, and September 2012 applications are measured after 5, 0, 5, and 1 month, respectively (Figure 5.3.2). After the November 2005 application, the maximum concentration is measured within the same month of application and therefore reported as zero. Generally, it is noted that the maximum bromide concentrations are measured after the first drainage event following an application. Although the maximum concentrations are measured relatively fast in drainage samples after bromide applications, detections of bromide are continuous throughout all monitoring periods.

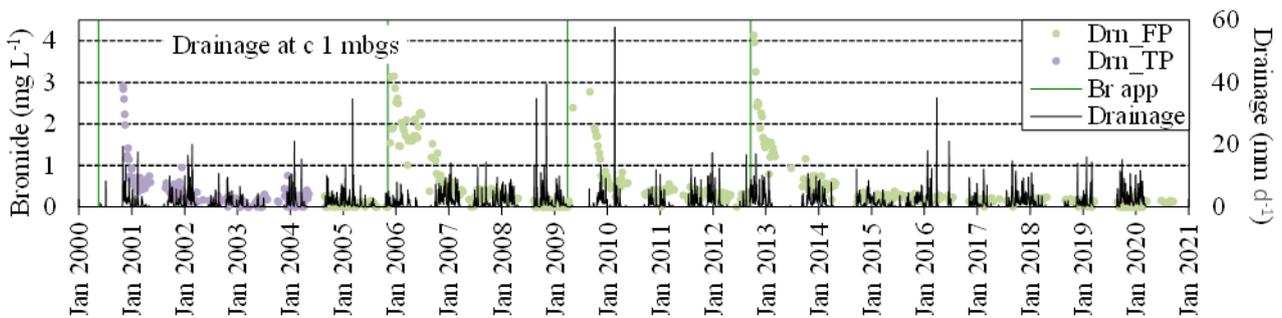


Figure 5.3.2. Measured bromide concentration in drainage at Estrup. The suffix FP and TP refer to flow- and time-proportional sampling, respectively, which are described in Kjær et al. (2004) and Appendix 2.

In groundwater, sampling results are based on measured bromide concentrations in wells M1-M6 and the horizontal monitoring wells (Figure 2.3.1). M7 is regarded as an upstream well. However, as bromide is measured in M7, although in low concentrations (generally < 0.5 mg/L), further analysis of the flow field is needed to fully understand the groundwater flow dynamics across the field. Such analyses are under preparation for all the fields. However, for the sake of simplicity, in the present analysis, M7 is assumed not to be part of the flow field represented by the remaining wells.

In the groundwater samples from ~2 mbgs, the maximum bromide concentrations after May 2000, November 2005, and September 2012 applications are measured within 18-44, 10-40, 1-41, and 5-88 months (Figure 5.3.3).

In the groundwater samples from ~3 mbgs, the maximum bromide concentrations after May 2000, November 2005, and September 2012 applications are measured within 9-46, 7-25, 5-34, and 5-20 months (Figure 5.3.3).

In the groundwater samples from ~4 mbgs, the maximum bromide concentrations after May 2000, November 2005, and September 2012 applications are measured within 4-49, 2-30, 2-39, and 4-20 months (Figure 5.3.3).

In the groundwater samples from ~5 mbgs, the maximum bromide concentrations in May 2000, November 2005, and September 2012 applications are measured within 9-49, 10-33, 2, and 5 months (Figure 5.3.3).

For each depth, the average breakthrough time for maximum bromide concentrations is calculated from the time of measured maximum concentration within each of the wells representing that particular depth. Thus, for the May 2000, November 2005, April 2009, and September 2012 applications, the average breakthrough time for maximum bromide concentrations reaching depths at around 2, 3, 4, and 5 mbgs are 27, 21, 20, and 24 months, respectively. However, in general, continuous data series are scarce and therefore challenging to interpret overall bromide breakthrough patterns.

After the May 2000 application, there seems to be a pattern of bimodal breakthrough (Figure 5.3.3) which was also seen at Silstrup (Figure 5.2.3) and also the timing of the breakthroughs is similar. This indicates that the breakthroughs are governed by precipitation events generating fast flows. In general, there are no clear patterns in the average breakthrough time for the maximum concentrations reaching the different screen depths, although increasing transport time with increasing depth would be expected in a homogeneous setting. Also, the sampling is not sufficient to achieve a general pattern of the bromide pulse breakthroughs within the different depths. After the April 2009 and September 2012 applications, the fast occurrences in some well locations are lowering the average breakthrough time for maximum concentration. However, these fast occurrences immediately after an application may not represent the actual application. E.g., in M1 at ~2 mbgs, the maximum concentration is observed within a month from the April 2009 application, while the maximum concentration of the previous application is measured within a month before the April 2009 application (Figure 5.3.3). Hence, it is difficult to discern which application the maximum concentration following the April 2009 application represents. Nevertheless, the fast breakthrough of maximum bromide concentrations in drainage samples affirms that preferential flow paths are present in the variably saturated zone. Further, the range in which the maximum bromide concentrations are measured varies substantially from a few months to several years and supports that the flow and transport field is affected by heterogeneity related to clay-till settings comprising preferential flow paths as well as low permeable sediments.

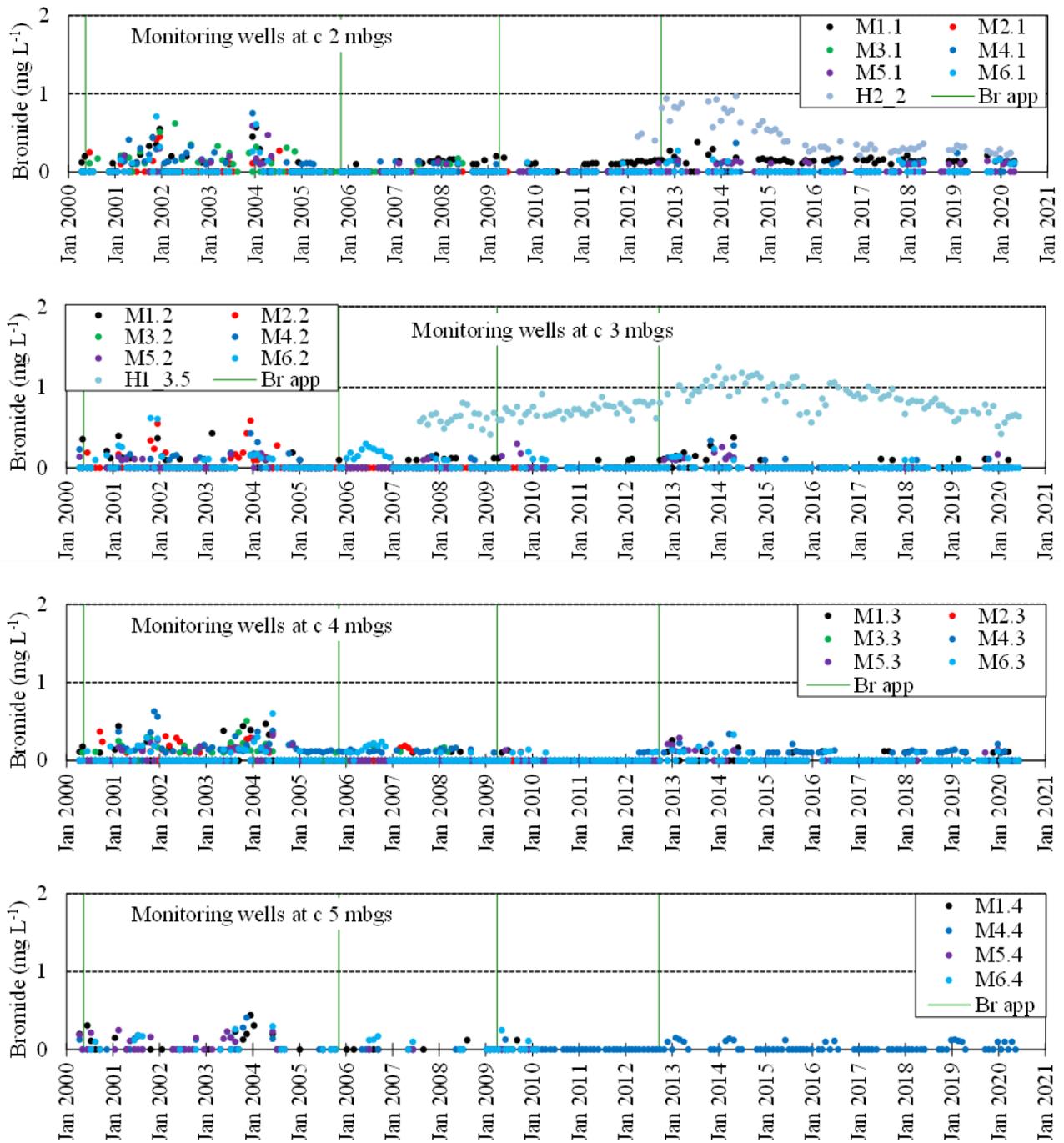


Figure 5.3.3. Measured bromide concentrations in the groundwater at Estrup.

In general, the majority of the maximum bromide concentrations reach the screens at ~2-5 mbgs within ~2 years after application, but maximum concentration levels are measured up to several years after application. For all the sampled depths, it is noted that bromide concentrations above the detection limit are measured before and after the transport times representing maximum concentrations.

## 5.4 Bromide leaching at Faardrup

At Faardrup, bromide was applied three times (October 1999, August 2008, and April 2012) as 30 kg/ha potassium bromide.

In the suction cups, samples were only collected with the October 1999 and April 2012 applications. In the suction cups located 1 mbgs, the maximum bromide concentrations after October 1999 and April 2012 applications are measured within 6-15 and 13-15 months (Figure 5.4.1).

In the suction cups located 2 mbgs, the maximum bromide concentrations after October 1999 and April 2012 applications are measured within 48 and 26-43 months (Figure 5.4.1).

The time range in which the maximum concentrations are measured in the suction cups at 1 mbgs is overall 12 months after application, while at 2 mbgs, the average time for the breakthrough of maximum concentrations is much slower around 41 months (Figure 5.4.1). After the April 2012 application, it is noted that at suction cups in the S1 nest, the measured concentrations are substantially higher compared to those measured at nest S2. Here, concentrations are up to a factor of 20 higher in nest S1 compared to S2. The reason for this is unknown and not readily explained. Despite the difference in concentration magnitude, the pattern of the measured breakthrough curve at 1 mbgs of S1 and S2 is similar. Generally, the pulse of breakthrough curves in the variably saturated zone is wider compared to those observed at the sandy field Jynde vad (Figure 5.1.1) and coincident with those observed at the other clay-till fields (Fig 5.2.1 and 5.3.1).

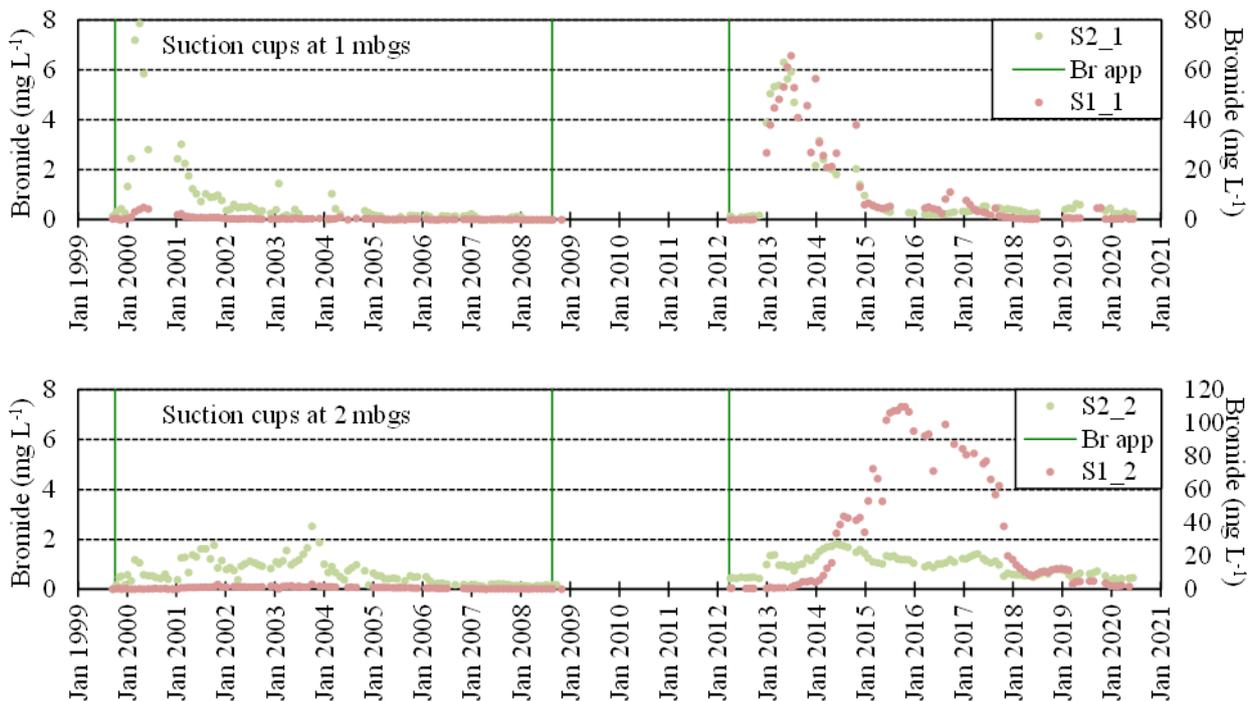


Figure 5.4.1. Measured bromide concentrations at Faardrup. The measured concentrations in the S1 nest are substantially larger than those measured in the nest S2. Therefore, the S1 measurements are denoted on the right y-axis.

The samples representing drainage from around 1 mbgs are collected in a drain well collecting drainage from the entire field (Figure 5.4.2). Therefore, no ranges are reported for the drainage samples. The maximum concentrations in the drainage after October 1999, August 2008, and April 2012 applications are measured after 16, 10, and 9 months, respectively (Figure 5.4.2). Compared to the other clay-till fields (Silstrup and

Estrup), where the maximum bromide concentrations are measured after the first drainage event following an application, Faardrup seems to differ. Here, maximum concentrations are not necessarily coincident with the first drainage event. Still, detections of bromide during drainage events are continuous throughout all monitoring periods.

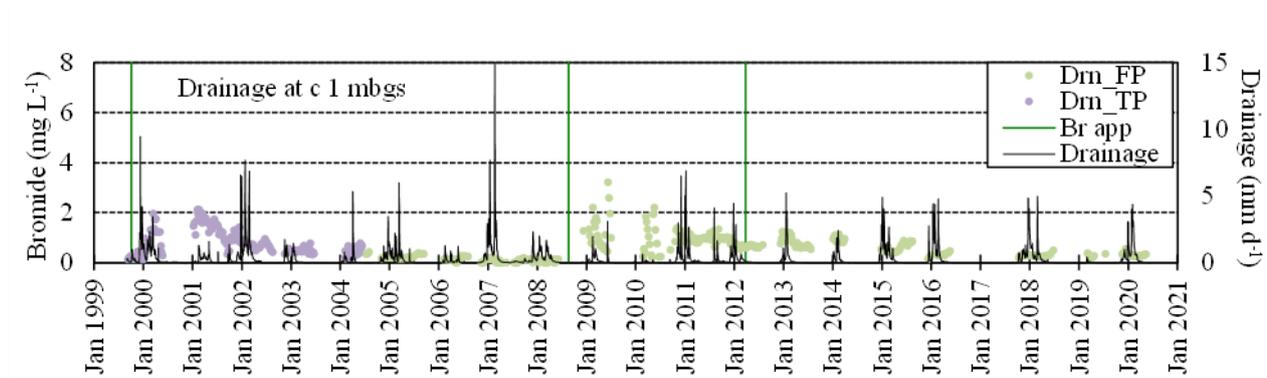


Figure 5.4.2. Measured bromide concentrations in the drainage at Faardrup. The suffix FP and TP refer to flow- and time-proportional sampling, respectively, which are described in Kjær et al. (2004) and Appendix 2.

In the groundwater sampling, results are based on measured bromide concentrations in all wells except M2 (Figure 5.4.3). M2 is regarded as an upstream well. However, as bromide is measured in M2, although in low concentrations (generally < 0.5 mg/L), further analysis is needed to fully understand the groundwater flow dynamics across the field. Such analyses are under preparation for all the fields. However, for the sake of simplicity, in the present analysis, M2 is assumed not to be part of the flow field represented by the remaining wells.

In the groundwater samples from ~2 mbgs, the maximum bromide concentrations after October 1999, August 2008, and April 2012 applications are measured within 24-56, 10-34, and 3-25 months (Figure 5.4.3).

In the groundwater samples from ~3 mbgs, the maximum bromide concentrations after October 1999, August 2008, and April 2012 applications are measured within 24-57, 10-40, and 26-62 months (Figure 5.4.3).

In the groundwater samples from ~4 mbgs, the maximum bromide concentrations after October 1999, August 2008, and April 2012 applications are measured within 26-67, 11-42, and 61-90 months (Figure 5.4.3).

In the groundwater samples from ~5 mbgs, the maximum bromide concentrations in October 1999, August 2008, and April 2012 applications are measured within 49-55, 11-34, and 62-63 months (Figure 5.4.3).

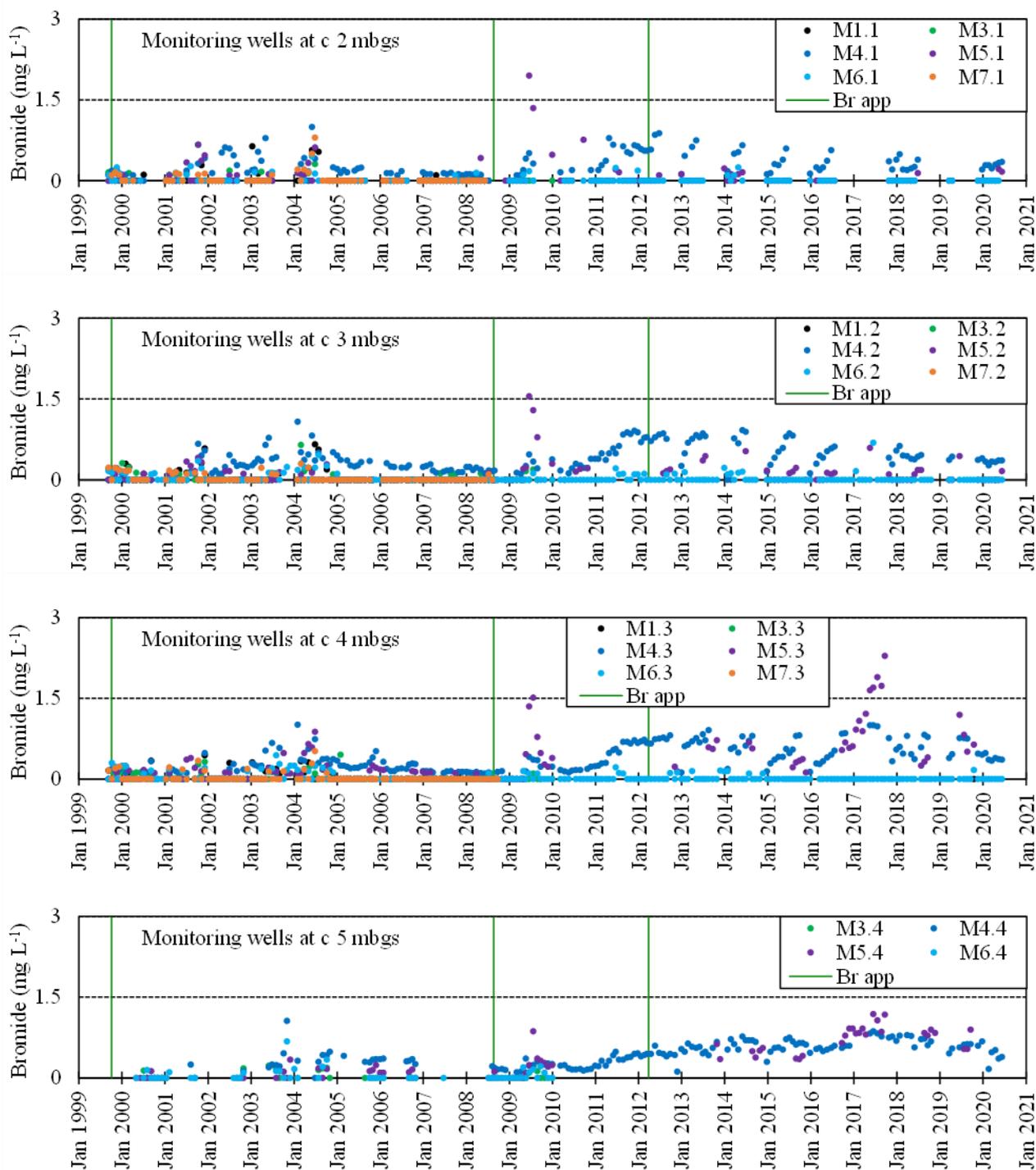


Figure 5.4.3. Measured bromide concentrations in the groundwater at Faardrup.

The average breakthrough time for maximum bromide concentrations is calculated from the time of measured maximum concentration within each of the wells representing a particular depth. Thus, for the October 1999, August 2008, and April 2012 applications, the average time for maximum bromide concentrations reaching depths at around 2, 3, 4, and 5 mbgs are 31, 44, 51, and 47 months, respectively. However, especially in the case of Faardrup, the average breakthrough time for the maximum concentration is difficult to use as a proxy for transport to the well screens. Hence, the sampling is not sufficiently detailed

to achieve a general pattern of the bromide breakthroughs within the different depths. But from the depth interval around 2 to 4 mbgs, the average breakthrough times for maximum concentrations reaching the screens are increasing with depth from around 12 months to 51 months. From the depth interval around 4 to 5 mbgs, the average breakthrough time for the maximum concentration decreases from 51 to 47 months. This could be an artifact of having samples from fewer screens at ~5 mbgs, where the number of screens used to compute the average maximum concentration times is based on the average of eight screens compared to an average of 12-13 screens at the other depths.

Compared to the other clay-till fields (Silstrup and Estrup), the average breakthrough time for maximum concentrations to reach the different monitoring depths is longer at Faardrup. In the variably saturated zone in Faardrup, the average breakthrough time for maximum concentration to reach 1 mbgs is one year compared to half a year or less at the other clay-till fields. Similarly, at 2 mbgs at Faardrup, the maximum concentrations arrive after more than three years compared to around two years at the other clay-till fields. In the groundwater monitoring wells at Faardrup, the average breakthrough time for maximum concentrations at depths of ~2-5 mbgs vary between ~3-4 years, whereas the average breakthrough time at similar depths at the other clay-till sites varies between ~1-2 years. Based on these results, it seems that there is a general pattern of slower transport of bromide at Faardrup compared to the other clay-till fields.

In general, the majority of the breakthroughs for maximum bromide concentrations reach the screens at ~2-5 mbgs within 3.5 years after application, but bromide is detected in concentrations similar to the maximum concentration levels up to several years after application. For all the sampled depths, it is noted that bromide concentrations above the detection limit are measured before and after the transport times representing maximum concentrations.

## **5.5 Bromide leaching at Lund**

Measurements of bromide concentrations at Lund differ substantially compared to the other fields. Firstly, the overall concentration magnitudes in the variably saturated zone and drainage (Figure 5.5.1), or groundwater (Figure 5.5.2) are the lowest measured in all the monitored fields. Secondly, the background concentrations measured in groundwater before the bromide application do not seem to differ compared to concentrations measured after the application (Figure 5.5.2). The reason for these apparent deviations is not currently known and needs further examination. Perhaps the application concentration was erroneous, or the screens are not sufficiently in hydraulic contact with the groundwater system. Due to the uncertainty of the previous bromide test, a new bromide test will be done in January 2023. Therefore, analysis of bromide measurements at Lund are not currently conducted but will be done, once the new bromide data are available.

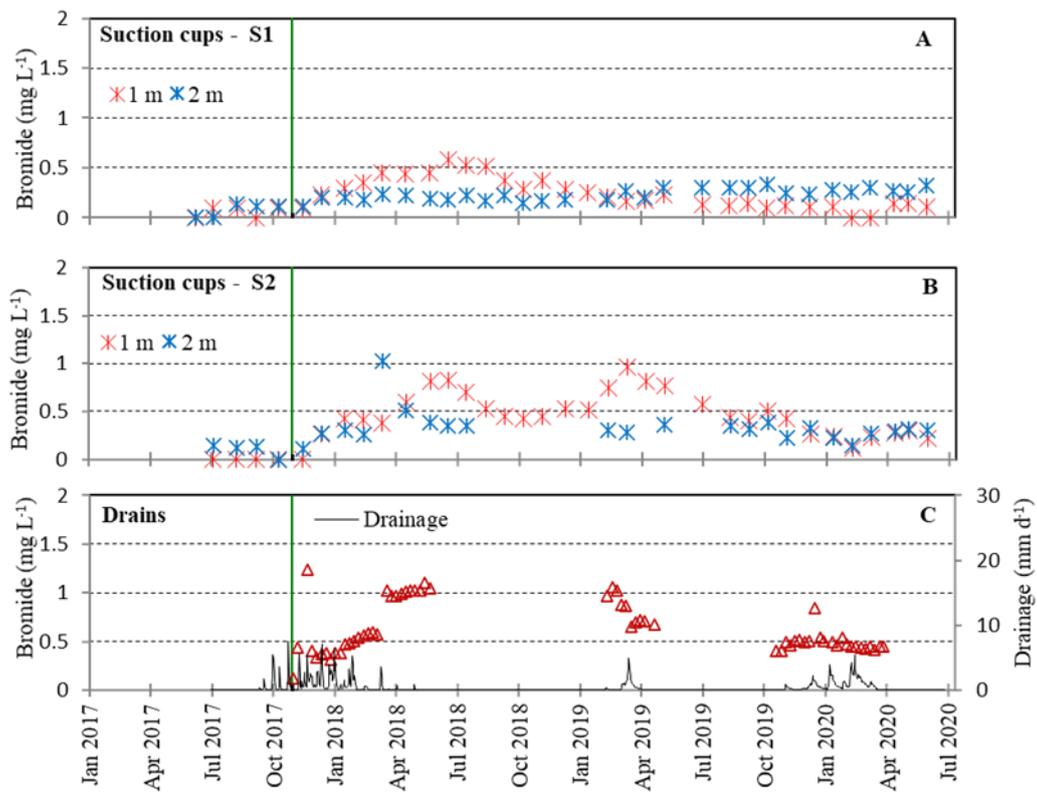


Figure 5.5.1. Bromide concentrations at Lund. A and B refer to suction cups located at S1 and S2 (see Figure 2.5.1). The bromide concentration is also shown for drainage water (C). The green vertical line indicates the date of bromide application.

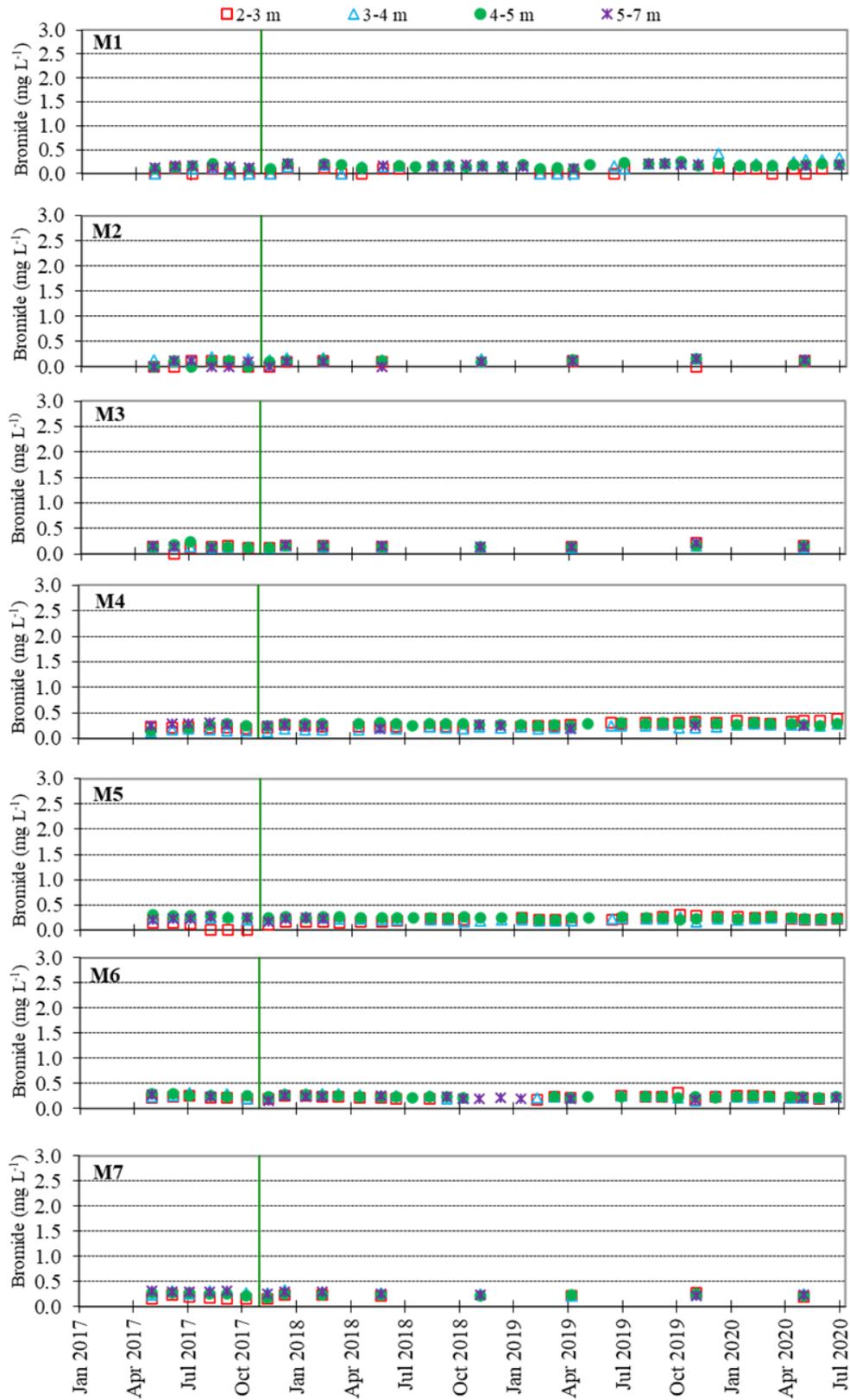


Figure 5.5.2. Bromide concentrations in the groundwater at Lund. The data derive from the vertical monitoring wells M1-M7. Screen depth is indicated in mbs. The green vertical lines indicate the date of bromide application.



## 6. Evaluation of pesticide tests

In this chapter, each pesticide is evaluated separately, which is in contrast to the previous reports, where each monitoring field was covered separately in terms of evaluation of compounds applied in the specific field. This means that in the present report, results of a pesticide test are reported as a whole, covering its application in all fields included in the specific test. Further, it is noted that the present reporting period covers the monitoring period ending 30 June 2022 so testing of compounds initiated in 2022 was mentioned but not evaluated. However, these compounds will be evaluated in the forthcoming report.

In previous reports, the reporting period was covering two years, with one year overlap. However, as this report covers data from two years 2020-2022 with no overlap, the pesticide tests evaluated in this present report are initiated within this period and in the years 2018-2019 and thus monitoring was done during 2020-2022. A short overview of the pesticide tests in each field is given in the next section and followed by an evaluation of each pesticide test.

For information on the agricultural management and related use of pesticides in the fields (viz. pesticides not included in the monitoring), please refer to Chapter 3 and Appendix 3. For agricultural management before 2019, please refer to the previous report (Badawi *et al.* 2022, available at [www.plap.dk](http://www.plap.dk)).

### 6.1 Pesticide tests at individual fields

#### *Pesticides in test at Jynde vad*

The fungicide Thiophanate-methyl was applied in winter wheat in June 2018 and the thiophanate-methyl degradation product, carbendazim, was included in the monitoring in October 2018.

The fungicide proquinazid was applied twice in winter rye (seed coated with fludioxonil) in April and May 2019. The two proquinazid degradation products, IN-MM671 and IN-MM991 were included in the monitoring in April 2019.

The fungicide cyazofamid and the insecticide acetamiprid were applied in potatoes in 2020. In total, cyazofamid was applied six times from June to September, whereas acetamiprid was applied twice (in June and July). Four degradation products from cyazofamid, DMS, DMSA, CCIM, and CTCA, and two degradation products from acetamiprid, IM-1-4, and IM-1-5 were included in the monitoring in May 2020. No pesticide test was initiated in 2021. The herbicide tribenuron-methyl was applied in spring barley (seed coated with tebuconazole and prothioconazole) in April 2022, and the fungicides prothioconazole and fluopyram were applied in May 2022. Three degradation products from tribenuron-methyl, IN-B5528, IN-R9805, and M2, and fluopyram and its degradation product, fluopyram-7-hydroxy, were included in the monitoring in February 2022. The common degradation product from azoles, 1,2,4-triazole, was continuously monitored during the period.

Figure 6.1.1 shows all applications of pesticides at Jynde vad from July 2019 to June 2022. For each pesticide, it is indicated whether it was included in the monitoring or not. Since Jynde vad is irrigated during the dry months, this is also indicated in the figures. For more details about agricultural management at the field, please refer to Chapter 3.1.

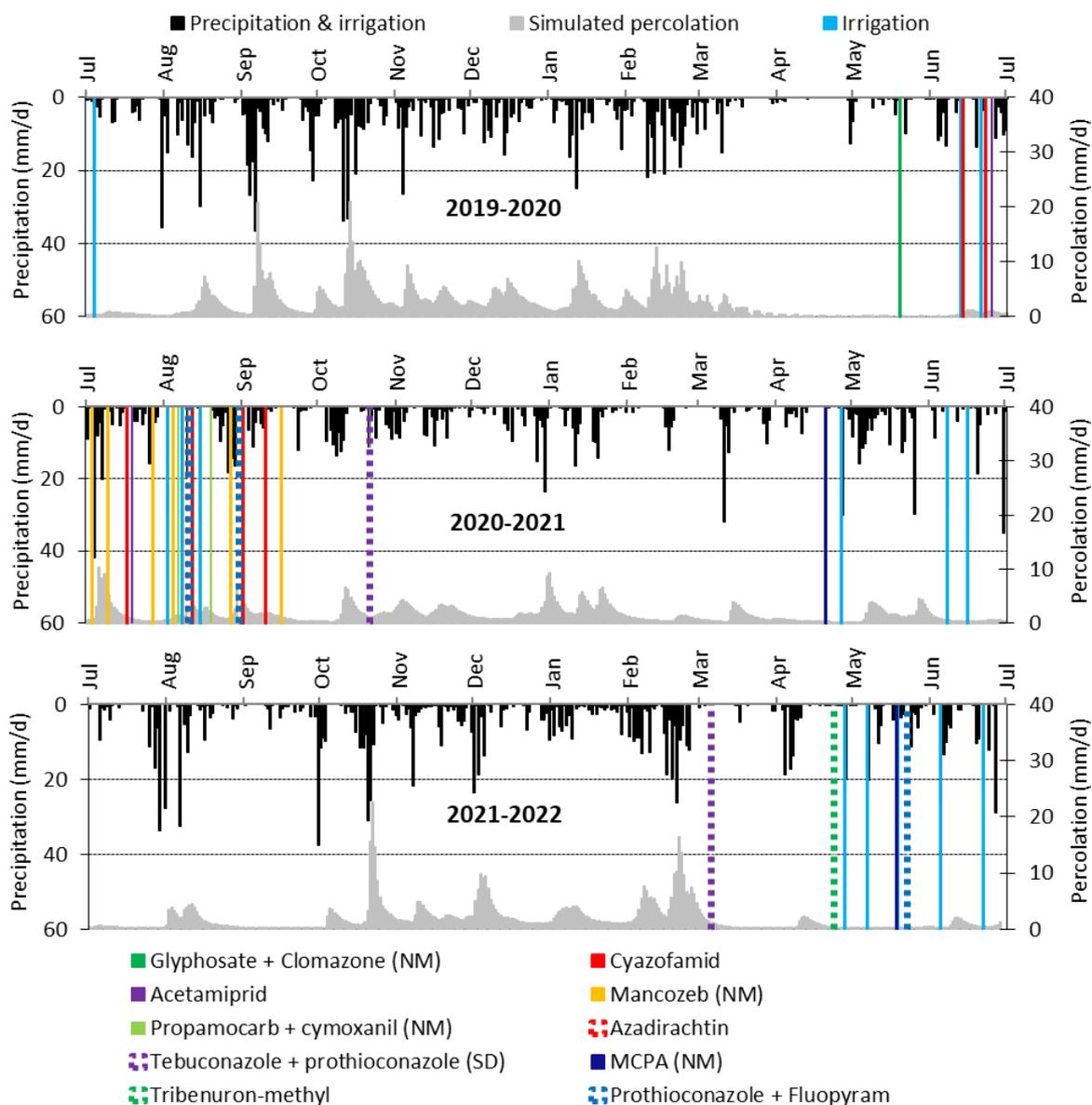


Figure 6.1.1. Application of pesticides at Jynde vad. Substances that were not included in the monitoring programme are marked (NM). Pesticides applied as seed dressings are marked (SD).

#### Pesticides in test at Silstrup

The herbicides cycloxydim and propyzamide were applied in winter rape (seed coated with Thiram) in September and November 2018, respectively, and propaquizafop in April 2019. Two cycloxydim degradation products E/Z-BH-517-TSO and BH-517-T2SO<sub>2</sub> were included in the monitoring in September 2018 and Propyzamide was included in October 2018. The four propaquizafop degradation products, PPA, CGA 287422, CGA 290291, and CGA 294972 were included in the monitoring in April 2019.

Two herbicides, pyroxsulam, and florasulam were used in winter wheat (seed coated with fludioxonil) in April 2020. Five degradation products from pyroxsulam, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide, and four degradation products from florasulam, TSA, 5OH-florasulam, DFP-ASTCA, and DFP-TSA were included in the monitoring in March 2020. In May and June 2020, the winter wheat was additionally applied two fungicides, prothioconazole, and azoxystrobin. The azoxystrobin degradation product, CyPM was included in the monitoring in May 2020.

The fungicides, prothioconazole, and fluopyram were applied in the spring barley in June 2021. Fluopyram was included in the monitoring in April 2021.

The herbicide tribenuron-methyl was applied in winter wheat (seed coated with tebuconazole and fludioxonil) in April 2022, and the fungicides prothioconazole and fluopyram were applied in May and June 2022. Three degradation products from tribenuron-methyl, IN-B5528, IN-R9805 and M2, and fluopyram and its degradation product, fluopyram-7-hydroxy, were included in the monitoring in February 2022. The common degradation product from azoles, 1,2,4-triazole, was continuously monitored during the period.

Figure 6.1.2 shows all applications of pesticides at Silstrup from July 2019 to June 2022. For each pesticide, it is indicated whether it was included in the monitoring or not. For more details about agricultural management at the field, please refer to Chapter 3.2.

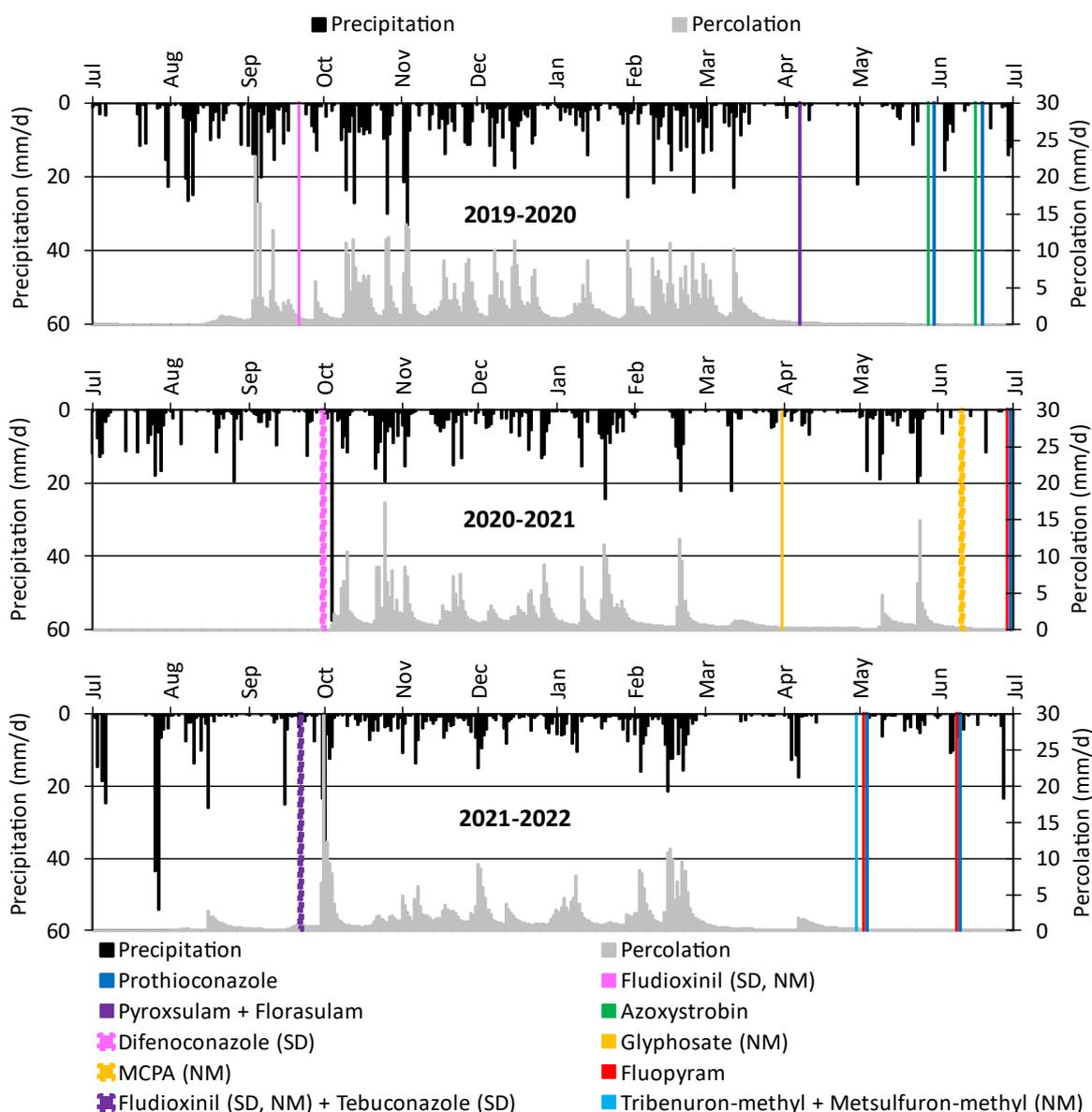


Figure 6.1.2. Application of pesticides at Silstrup. Substances that were not included in the monitoring programme are marked (NM). Pesticides applied as seed dressings are marked (SD).

### *Pesticides in test at Estrup*

The fungicide thiophanate-methyl was applied in winter wheat (seed coated with tebuconazole and prothioconazole) in June 2018 and the degradation product carbendazim was included in the monitoring in May 2018.

The herbicide halauxifen-methyl was applied in May 2019 and the fungicide metconazole was applied in May and June 2019 in spring barley (seed coated with tebuconazole and prothioconazole). The halauxifen-methyl degradation product X-729 and metconazole was included in the monitoring in April 2019 and the common degradation product from azoles, 1,2,4-triazole, was continuously monitored during the period.

Two pesticides, pyroxsulam, and florasulam were applied in winter wheat (seed coated with tebuconazole and prothioconazole) in May 2020. Five degradation products from pyroxsulam, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide, and four degradation products from florasulam, TSA, 5OH-florasulam, DFP-ASTCA, and DFP-TSA, were included in the monitoring in April 2020. One pesticide, thifensulfuron-methyl was applied in spring barley (seed coated with tebuconazole and prothioconazole) in June 2021 and the three thifensulfuron-methyl degradation products, IN-JZ789, IN-B5528, and IN-L9223 were included in the monitoring in April 2021. The monitoring of the three degradation products continued in 2022 as thifensulfuron-methyl this year was reapplied in July 2022 in a mixture of perennial ryegrass varieties.

Figure 6.1.3 shows all applications of pesticides at Estrup from July 2019 to June 2022. For each pesticide, it is indicated whether it was included in the monitoring or not. For more details about agricultural management at the field, please refer to Chapter 3.3.

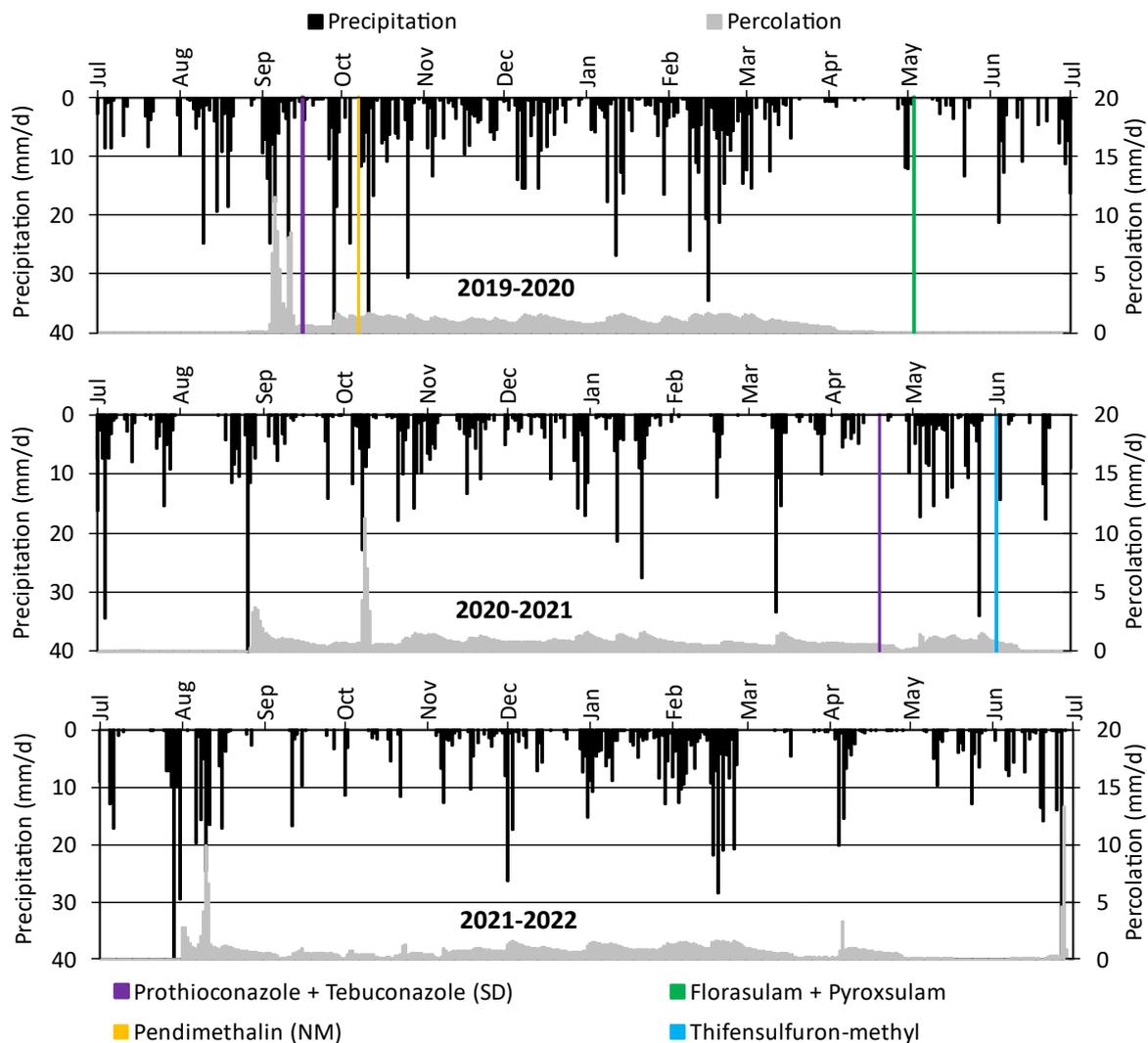


Figure 6.1.3. Application of pesticides at Estrup. Substances that were not included in the monitoring programme are marked (NM). Pesticides applied as seed dressings are marked (SD).

#### Pesticides in test at Faardrup

The fungicide proquinazid was applied twice in spring barley (seed coated with tebuconazole and prothioconazole) in June 2019. Two degradation products, IN-MM671 and IN-MM991 were included in the monitoring in April 2019.

The herbicide propyzamide was applied in winter rapeseed in November 2020 and the compound was included in the monitoring in October 2020. The fungicides, prothioconazole, and fluopyram were applied in the winter rapeseed in May 2021. Fluopyram was included in the monitoring in April 2021. Prothioconazole and fluopyram were reapplied in winter wheat (seed coated with tebuconazole and prothioconazole) twice in May 2022. The herbicide tribenuron-methyl was applied in winter wheat in April 2022. Three tribenuron-methyl degradation products, IN-B5528, IN-R9805, and M2, and one additional fluopyram degradation product, fluopyram-7-hydroxy were included in the monitoring in February 2022. The common degradation product from azoles, 1,2,4-triazole, was continuously monitored during the period.

Figure 6.1.4 shows all applications of pesticides at Faardrup from July 2019 to June 2022. For each pesticide, it is indicated whether it was included in the monitoring or not. For more details about agricultural management at the field, please refer to Chapter 3.4.

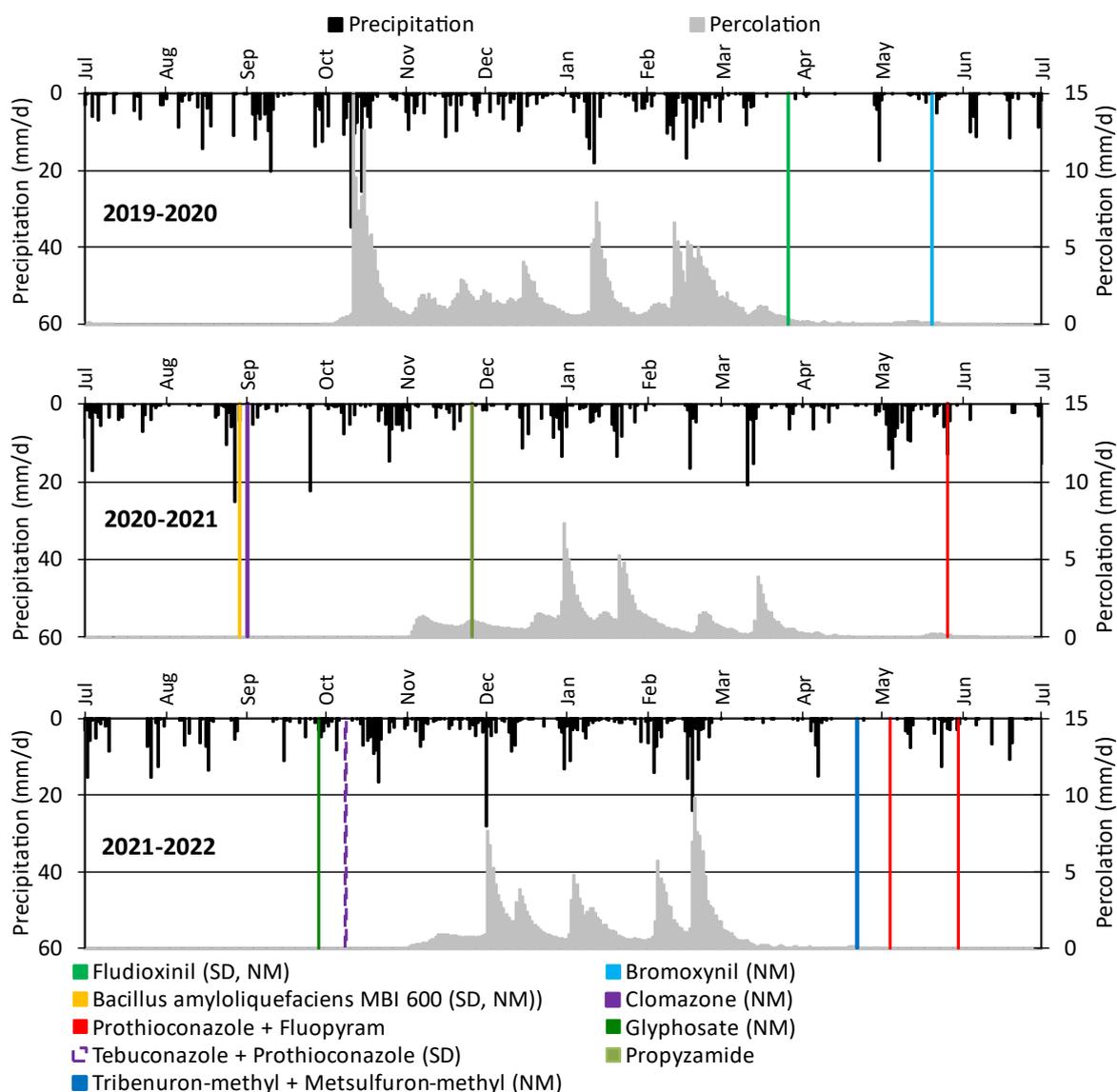


Figure 6.1.4. Application of pesticides at Faardrup. Substances that were not included in the monitoring programme are marked (NM). Pesticides applied as seed dressings are marked (SD).

#### Pesticides in test at Lund

The herbicide florasulam and the fungicide prothioconazole were applied to spring barley (seed coated with tebuconazole and prothioconazole) in May 2018 and prothioconazole was reapplied in June. The degradation products TSA from florasulam and 1,2,4-triazole were included in the monitoring in April 2018. Florasulam was reapplied in May 2019 together with the herbicide halauxifen-methyl in winter barley (seed coated with tebuconazole and prothioconazole) and the halauxifen-methyl degradation product, X-729 was included in the monitoring in April 2019. TSA was continuously monitored. The herbicides propyzamide, picloram, and halauxifen-methyl were applied in December 2019 in winter rapeseed. Propyzamide and the two propyzamide degradation products, RH-24580 and RH-24644 were included in the monitoring in October

2019, and picloram in November 2019. The halauxifen-methyl degradation product, X-729 was continuously monitored.

No pesticide tests were initiated at Lund in 2020.

The fungicides, fluopyram, and prothioconazole were applied in winter wheat (seed coated with tebuconazole and prothioconazole) in June 2021. The common degradation product from azoles, 1,2,4-triazole was continuously monitored, but fluopyram was included in the monitoring in April 2021.

In 2022, tribenuron-methyl, prothioconazole, and fluopyram were applied in spring barley (seed coated with tebuconazole and prothioconazole) in May. Fluopyram was continuously monitored. Three degradation products from tribenuron-methyl, IN-B5528, IN-R9805, M2, and one additional fluopyram degradation product, fluopyram-7-hydroxy, were included in the monitoring in February 2022. The common degradation product from azoles, 1,2,4-triazole, was continuously monitored during the period.

Figure 6.1.5 shows all applications of pesticides at Lund from July 2019 to June 2022. For each pesticide, it is indicated whether it was included in the monitoring or not. For more details about agricultural management at the field, please refer to Chapter 3.5.

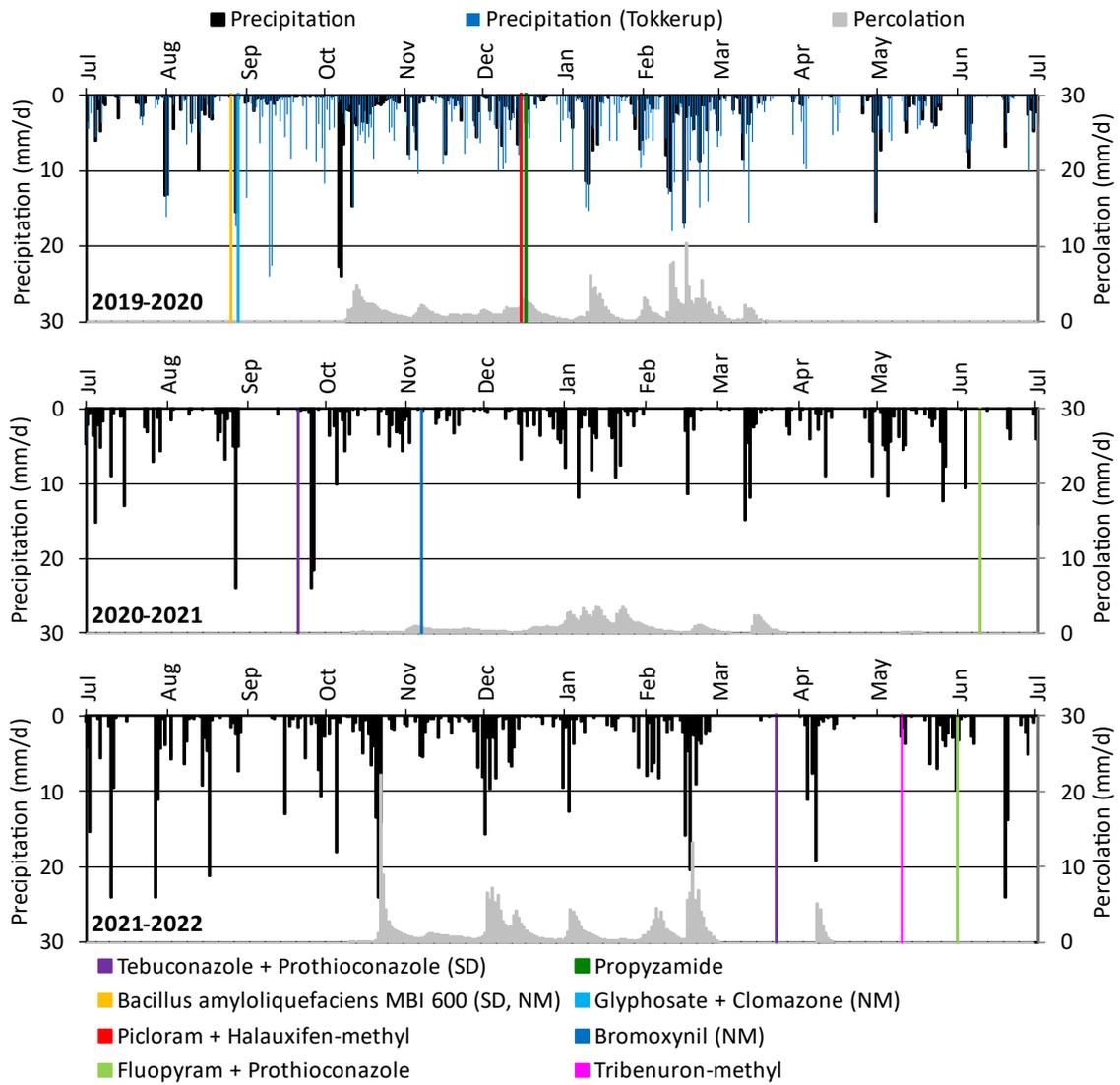


Figure 6.1.5. Application of pesticides at Lund. Substances that were not included in the monitoring programme are marked (NM). Pesticides applied as seed dressings are marked (SD).

## Evaluation of pesticide tests from July 2020 to June 2022

Note that some of the pesticide tests included in the current report were initiated prior to the beginning of the reporting period, i.e. before 1 July 2020. The individual reporting periods are specified individually for each of the pesticide tests.

### 6.2 Acetamiprid test

Two degradation products, IM-1-4 and IM-1-5 from acetamiprid, are monitored in the current reporting period, July 2020-June 2022, following acetamiprid application on the sandy field Jyndeved. Detailed information on the field site is available in Chapter 2.

#### 6.2.1 Application of acetamiprid at Jyndeved

Acetamiprid was tested in PLAP in connection with cropping of potatoes at Jyndeved in 2020. Acetamiprid was applied at Jyndeved on June 23, and July 17, 2020. Detailed information on agricultural management is available in chapter 3, appendices 3 and 7, and previous PLAP reports.

Acetamiprid was previously applied in a potato crop at Jyndeved in 2014, but neither acetamiprid nor any of its degradation products were included in the monitoring at the time. The agricultural management from this period is described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk).

#### 6.2.2 Compounds included in the monitoring

Two degradation products, IM-1-4 and IM-1-5, from acetamiprid were selected for monitoring at Jyndeved starting in April 2020 and continuing until June 2022.

Monitoring of the degradation products started in April 2020, but the analytical methods for analyses of IM-1-4 and IM-1-5 were not ready. Consequently, the water samples collected from April to October 2020 were stored at -20°C (refer to Chapter 7) after which the analytical methods were ready. The effect of storing the samples is currently unknown but relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). In total 65 of 265 samples were stored before analysis. Monitoring of IM-1-4 and IM-1-5 is ongoing.

#### 6.2.3 Results of the IM-1-4 and IM-1-5 monitoring

IM-1-4 and IM-1-5 were introduced in the monitoring in April 2020 and the first acetamiprid application was on June 23, 2020. In total, 31 samples were collected in suction cups and monitoring wells, before the acetamiprid application and none of these contained IM-1-4 and IM-1-5.

Water used for irrigation of the field was additionally analysed for both IM-1-4 and IM-1-5. One irrigation water sample was collected in June 2020 before the acetamiprid application, and five were collected and analysed from June 23, 2020, to July 1, 2022. IM-1-4 and IM-1-5 were not detected in any of the irrigation water samples.

An overview of the entire monitoring is given in Table 6.3.1 and shows the number of detections in water from suction cups and monitoring wells during the monitoring period from June 23, 2020, to July 2022.

Table 6.3.1. Number of samples and detections of IM-1-4 and IM-1-5 at Jynde vad in water from suction cups (S), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from June 23, 2020, to July 2022. Background samples collected before the application of acetamiprid and irrigation water samples are not included in the counting.

	Total			S			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
Jynde vad															
IM-1-4	234	0	0	48	0	0	173	0	0	13	0	0	186	0	0
IM-1-5	234	0	0	48	0	0	173	0	0	13	0	0	186	0	0

#### Suction cups and groundwater monitoring wells

A total of 48 and 186 samples were collected from suction cups and groundwater monitoring wells, respectively at Jynde vad in connection with the acetamiprid test from June 2020 to July 2022. IM-1-4 and IM-1-5 were neither detected in samples from the collected suction cups nor the groundwater wells (Table 6.3.1).

#### 6.2.4 Discussion and conclusion of the IM-1-4 and IM-1-5 monitoring

Acetamiprid was tested in a potato crop at Jynde vad in 2020. None of the two degradation products, IM-1-4 and IM-1-5, were detected in water from the suction cups, groundwater, or irrigation water, neither before the acetamiprid application (from April to June 2020) nor in the monitoring period from June 2020 to July 2022. In conclusion, IM-1-4 and IM-1-5 do not give rise to groundwater detections above the limit value during the present monitoring period, but the monitoring is ongoing and a final evaluation will be presented in the following PLAP report .

### 6.3 Azole fungicides test

Metconazole and the common azole degradation product, 1,2,4-triazole were monitored in the current monitoring period, July 2020-June 2022, following metconazole application at the clay till field Estrup. 1,2,4-triazole was monitored after propiconazole application at the sandy field Jynde vad and clay till field Faardrup, and prothioconazole applications at the clay till fields Silstrup and Lund. Further, in 2017 registration of seed dressings containing azoles (tebuconazole, prothioconazole, and difenoconazole) was initiated. Detailed information on the field sites included in the tests is available in Chapter 2.

#### 6.3.1 Application of azoles at Jynde vad, Silstrup, Estrup, Faardrup, and Lund

The azole pesticides were tested in PLAP with cropping of winter wheat, spring barley, and a catch crop of grass and clover during 2020-2022. Metconazole was applied at Estrup in spring barley in June 2022, propiconazole was applied in a catch crop of grass and clover at Jynde vad in June 2016, and in spring barley in Faardrup in 2017, and prothioconazole was applied in winter wheat at Silstrup in June 2020, and in spring barley at Lund in May 2018.

Tebuconazole and prothioconazole were used as seed dressing several times during the monitoring period 2020-2022 (Figures 6.4.1-5, Chapter 3, Appendices 3 and 7).

The azole fungicides, tebuconazole, prothioconazole, epoxiconazole, propiconazole, and difenoconazole have previously been applied at the PLAP fields. Detailed information on previous azole applications and agricultural management is available in Chapter 3, Appendices 3 and 7, and previous PLAP reports.

### 6.3.2 Compounds included in the monitoring

1,2,4-triazole was included in the monitoring in 2014 at all fields, except at Lund, where the monitoring started in January 2018. The monitoring of 1,2,4-triazole is still ongoing in all five fields.

Metconazole testing at Estrup was initiated in June 2019, and metconazole was included in the monitoring in April 2019. The metconazole monitoring ended in March 2021.

### 6.3.3 Results of the 1,2,4-triazole and metconazole monitoring

As the azoles were applied several times during the period 1999-2014 in the fields before monitoring of 1,2,4-triazole was initiated in 2014 at the four fields, Jyndeved, Silstrup, Estrup, and Faardrup, and from 2018 at Lund, it is not possible to determine the background content of 1,2,4-triazole.

*Table 6.4.1. Number of samples and detections of 1,2,4-triazole at Jyndeved, Silstrup, Estrup, Faardrup, and Lund, and metconazole detections at Estrup in suction cups (Jyndeved only) and drainage (S/D), vertical monitoring wells (M) and horizontal wells (H). The counting comprises all samples collected latest azole spray application at each field: from June 2, 2016 to June 2022 at Jyndeved, May 28, 2020 to June 2022 at Silstrup, May 22, 2019 to June 2022 at Estrup (metconazole from June 13, 2019), June 19, 2017 to June 2022 at Faardrup, and May 30, 2018 to June 2022 at Lund. Samples collected before the included azole applications and analyses of irrigation water (Jyndeved) are not included in the counting.*

	Total			S*/D			M			H <sup>A</sup>			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Jyndeved</b>															
1,2,4-triazole	761	456	9	145*	75*	4*	569	358	5	47	23	0	616	381	5
<b>Silstrup</b>															
1,2,4-triazole	201	96	0	50	47	0	106	27	0	45	22	0	151	49	0
<b>Estrup</b>															
1,2,4-triazole	276	259	107	101	100	93	110	97	13	65	62	1	175	159	14
Metconazole	155	1	0	60	1	0	60	0	0	35	0	0	95	0	0
<b>Faardrup</b>															
1,2,4-triazole	408	134	6	109	107	6	236	13	0	63	14	0	299	27	0
<b>Lund</b>															
1,2,4-triazole	346	264	2	56	53	0	290	211	2	- <sup>A</sup>	- <sup>A</sup>	- <sup>A</sup>	290	211	2

\*data from suction cups at Jyndeved, <sup>A</sup> No horizontal monitoring well is installed at Lund.

#### Jyndeved

At Jyndeved, 1,2,4-triazole was included in the monitoring in 2014 and the results up to July 2020 are detailed in Badawi *et al.* (2022). The most recent application of an azole product in Jyndeved was tebuconazole and prothioconazole as seed dressing in March 2022, while the latest spraying application was propiconazole on June 2, 2016. Therefore, the current evaluation from the 1,2,4-triazole monitoring at Jyndeved covers June 2016-June 2022 (Figure 6.4.1).

#### Suction cups

From the suction cups 1 mbgs in the variably saturated zone, 1,2,4-triazole concentrations > 0.1 µg/L were detected in four samples from July 2016 to July 2017 (Figure 6.4.1C). Hereafter, no detections > 0.1 µg/L were made, and interchanging periods with detections and non-detections occurred. From October 2017 to December 2019, 1,2,4-triazole is generally detected continuously in 1 mbgs from S2, while detections from S1 were sporadic after July 2018. From July 2018 until the end of June 2022, detections from S1 are limited

to five samples. In S2, 1,2,4-triazole detections, still < 0.1 µg/L, are generally observed during two six month-periods starting from August 2020 and May 2021 (Figure 6.4.1C).

#### Groundwater monitoring wells

From June 2016 to November 2018, detections of 1,2,4-triazole were made continuously in the downstream groundwater wells, M1 and M2, in concentrations < 0.1 µg/L. In M1, detections < 0.1 µg/L generally continued throughout the monitoring period (Figure 6.4.1D). Contrary to M1, the detection pattern in M2 differed from November 2018 to November 2019, where 1,2,4-triazole detections > 0.1 µg/L occurred with a maximum concentration of 0.18 µg/L in September 2019. After November 2019, 1,2,4-triazole concentrations < 0.1 µg/L occurred generally throughout the monitoring period in wells M1 and M2. In monitoring well M2, the M2.3 intake (2.9-3.9 mbgs) showed two six month-periods of increasing concentrations, still < 0.1 µg/L, starting from August 2020 and May 2021, respectively (Figure 6.4.1D).

Sampling from the downstream wells M4 and M5, and the horizontal well H1 showed relatively few detections of 1,2,4-triazole (Figure 6.4.1E). Hence, 13 samples of 147 samples from M4, 0 of 30 samples from M5, and 23 of 47 samples from H1 had 1,2,4-triazole detections and all detections were in concentrations < 0.1 µg/L with a maximum concentration reaching 0.04 µg/L.

In the upstream groundwater monitoring well M7, there were continuous 1,2,4-triazole detections (in 147 of 181 samples) from June 2016 to July 2022, though generally, the detections were in concentrations < 0.1 µg/L (Figure 6.4.1F). One 1,2,4-triazole detection was in a concentration > 0.1 µg/L and occurred in September 2019. Hereafter, similar to the downstream wells, the M7.3 intake showed two six month-periods of increasing concentrations, though < 0.1 µg/L, from August 2020 and July 2021, respectively (Figure 6.4.1F).

#### Irrigation water

Sixteen irrigation water samples were collected from the irrigation wells at Jyndevad during the dry seasons between June 2016 and July 2022. 1,2,4-triazole was not detected in any of the samples.

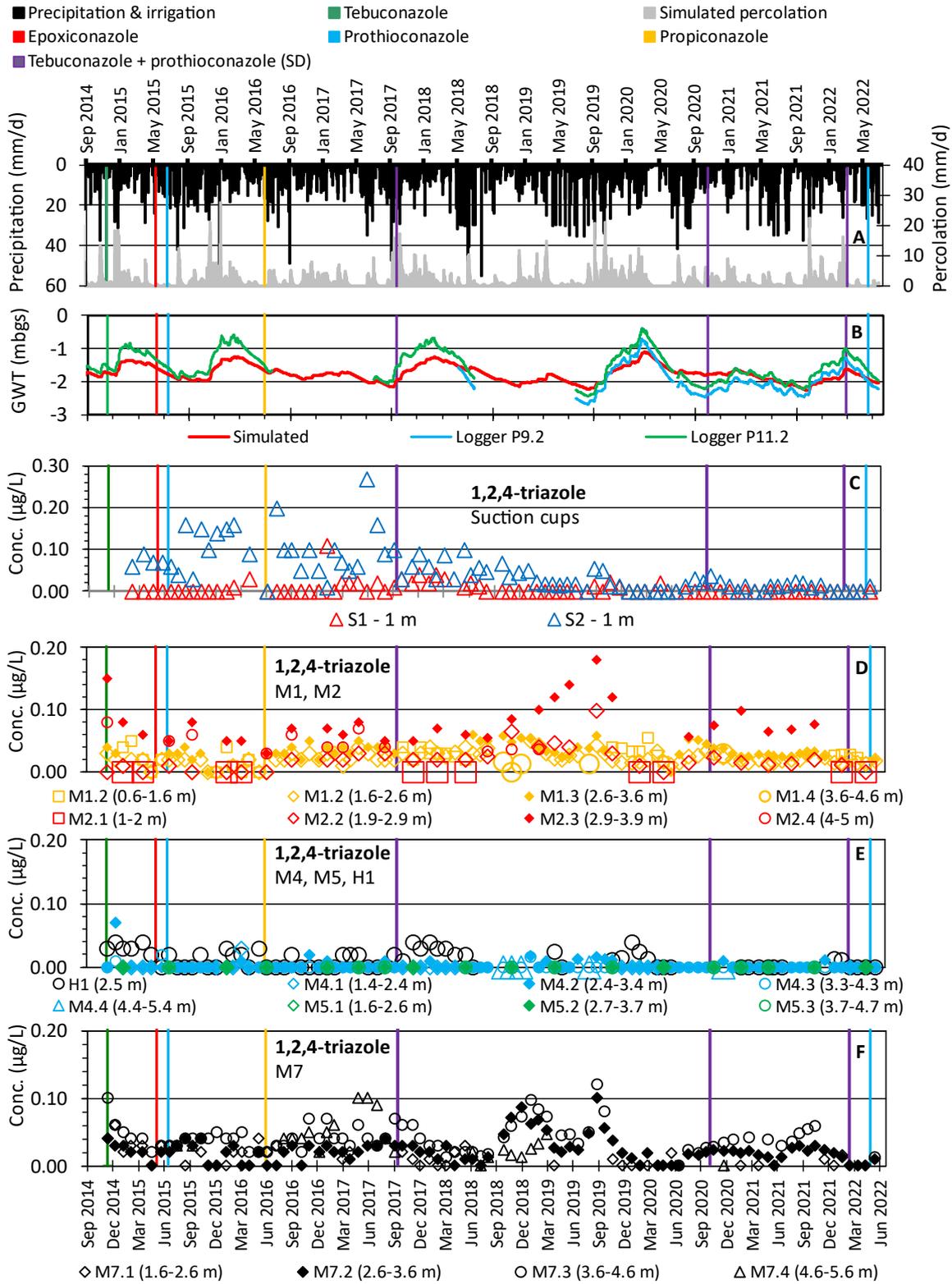


Figure 6.4.1. 1,2,4-triazole monitoring at Jynde vad. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); 1,2,4-triazole measured in the variably saturated zone (C); and in horizontal (H1) and vertical groundwater monitoring wells, M1, M2, M4, M5 (D-E), and upstream well M7 (F). It is noted that M7 is regarded as an upstream monitoring well. The secondary y-axis (plot C) represents the drainage flow. The vertical coloured lines indicate the date of azole applications. Note that the evaluated results cover June 2016-June 2022. SD, azoles applied as seed dressing (purple lines). Monitoring of 1,2,4-triazole is ongoing.

### Silstrup

At Silstrup, 1,2,4-triazole was included in the monitoring in 2017 and the results up to July 2020 are detailed in Badawi *et al.* (2022). The most recent application of an azole product in Silstrup, before the current monitoring of July 2020-June 2022, was a split application of prothioconazole initiated on May 28, 2020 (Figure 6.4.2). Therefore, the current evaluation from the 1,2,4-triazole monitoring covers May 2020-June 2022 (Figure 6.4.2).

#### Variably saturated zone monitoring

In the drainage, 1,2,4-triazole detections were observed in concentrations  $< 0.1 \mu\text{g/L}$  throughout the monitoring period May 2020-June 2022, when drain flow occurred (Figure 6.4.2C). As such, the first drainage event enabling drainage sampling (viz. when drainage is  $\geq 3000 \text{ L}$ ) occurred in October 2020 following a relatively large rainfall event in the same month (Figure 6.4.2A).

#### Groundwater monitoring wells

From May 2020 to June 2022, groundwater sampling from the downstream wells M5, M9, and M10, and horizontal wells H1 and H2 showed 1,2,4-triazole detections fluctuating in concentrations  $< 0.1 \mu\text{g/L}$ . For instance, in the horizontal wells, detections of 1,2,4-triazole primarily occurred concomitantly with periods of percolation and drainage flow (Figure 6.4.2D), while the first and maximum occurrence of 1,2,4-triazole ( $0.051 \mu\text{g/L}$ ) in the vertical monitoring wells coincided with the onset of drainage flow in October 2020 (Figure 6.4.2C and E). Aside from the first detections, both the horizontal and vertical monitoring wells generally showed detections in October 2020-March 2021 and June 2021-March 2022 (Figure 6.4.2D and E).

In the upstream groundwater monitoring well M12, no 1,2,4-triazole detections were made (Figure 6.4.2).

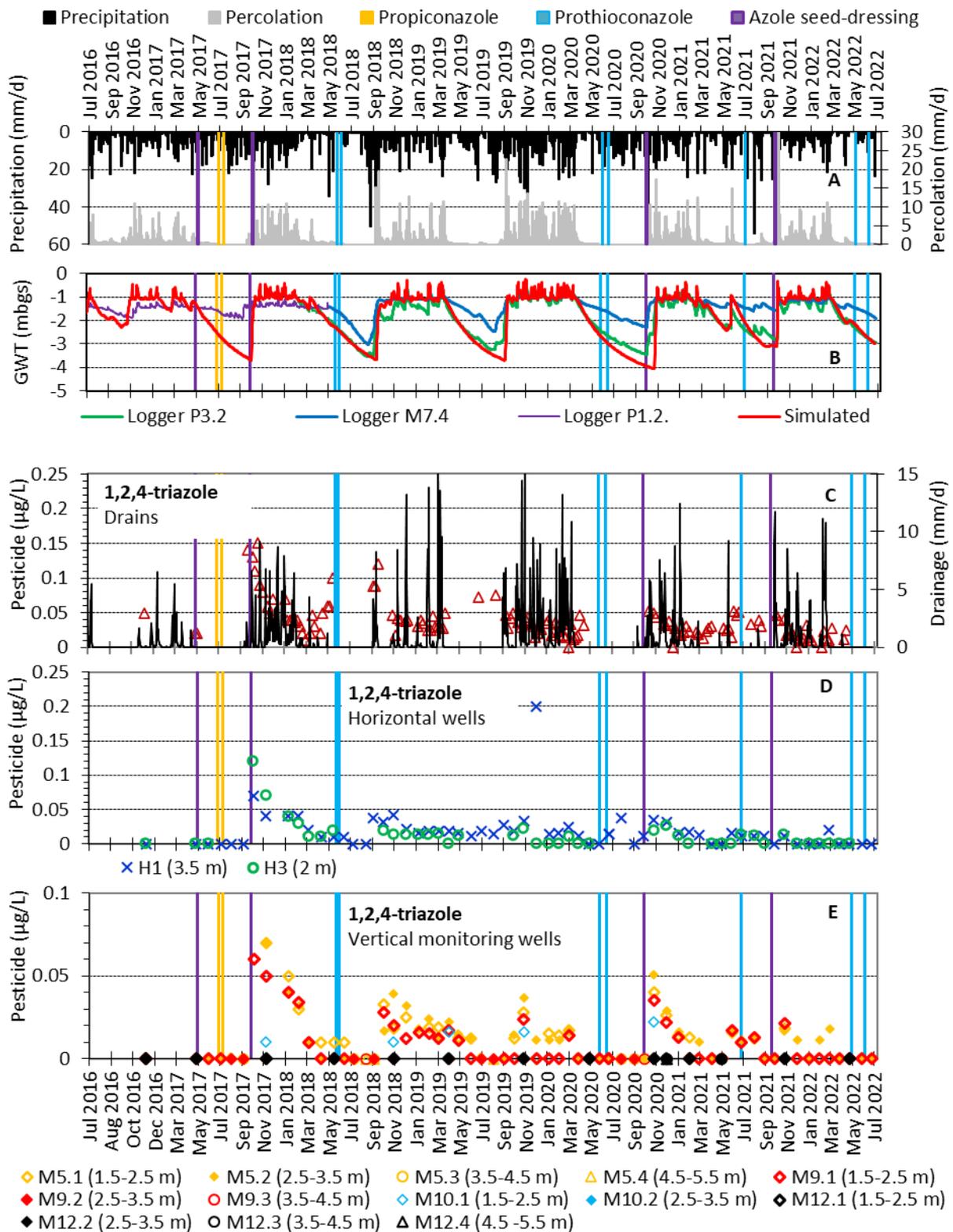


Figure 6.4.2. 1,2,4-triazole monitoring at Silstrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); 1,2,4-triazole measured in the variably saturated zone (C); and in horizontal wells H1 and H3 (D) and vertical groundwater monitoring wells, M5, M9, M10, M12 (E). It is noted that M12 is regarded as an upstream monitoring well. The secondary y-axis (plot C) represents the drainage flow. The vertical coloured lines indicate the date of azole applications. Note that the evaluated results cover May 2020-June 2022. SD, azoles applied as seed dressing (purple lines). Monitoring of 1,2,4-triazole is ongoing.

### *Estrup*

At Estrup, metconazole was introduced in the monitoring in April 2019 and metconazole was applied on May 22, and June 13, 2019. In total, 14 samples were collected in drainage and monitoring wells before the metconazole application in May, and none of these contained metconazole.

At Estrup, 1,2,4-triazole was included in the monitoring in 2014 and the results up to July 2020 are detailed in Badawi *et al.* (2022). The most recent application of an azole product in Estrup before the current monitoring period July 2020-June 2022 was the application of metconazole in May/June, 2019. As such, the evaluation results from the 1,2,4-triazole monitoring cover the period May 2019-June 2022.

### *Variably saturated zone monitoring*

In the drainage, 1,2,4-triazole detections are observed generally in all samples and primarily in concentrations > 0.1 µg/L throughout the evaluated monitoring period from May 2016 to June 2022 (Figure 6.4.3C). The maximum drainage concentration of 0.47 µg/L is observed in July 2020. Metconazole was detected once during the monitoring period from May 2019 to March 2021. This was in a drainage sample from July 2020 with a concentration < 0.1 µg/L (0.011 µg/L).

### *Groundwater monitoring wells*

From May 2020 to June 2022, sampling from the downstream wells M1, M4, M5 and M6, and horizontal wells H1 and H2 showed 1,2,4-triazole detections throughout the monitoring period. In M4, 1,2,4-triazole concentrations > 0.1 µg/L are detected in relatively long periods from October 2019 to March 2020 and September 2020 to February 2021 (Figure 6.4.3E). In wells M1, M5, M6, and H1, 1,2,4-triazole is detected throughout the monitoring period, though in concentration < 0.1 µg/L. In well H2, there is one detection > 0.1 µg/L in October 2019 (0.11 µg/L) after which all detections were < 0.1 µg/L (Figure 6.4.3D). Metconazole was not detected in groundwater during the monitoring period from May 2019 to March 2021 (Table 6.4.1).

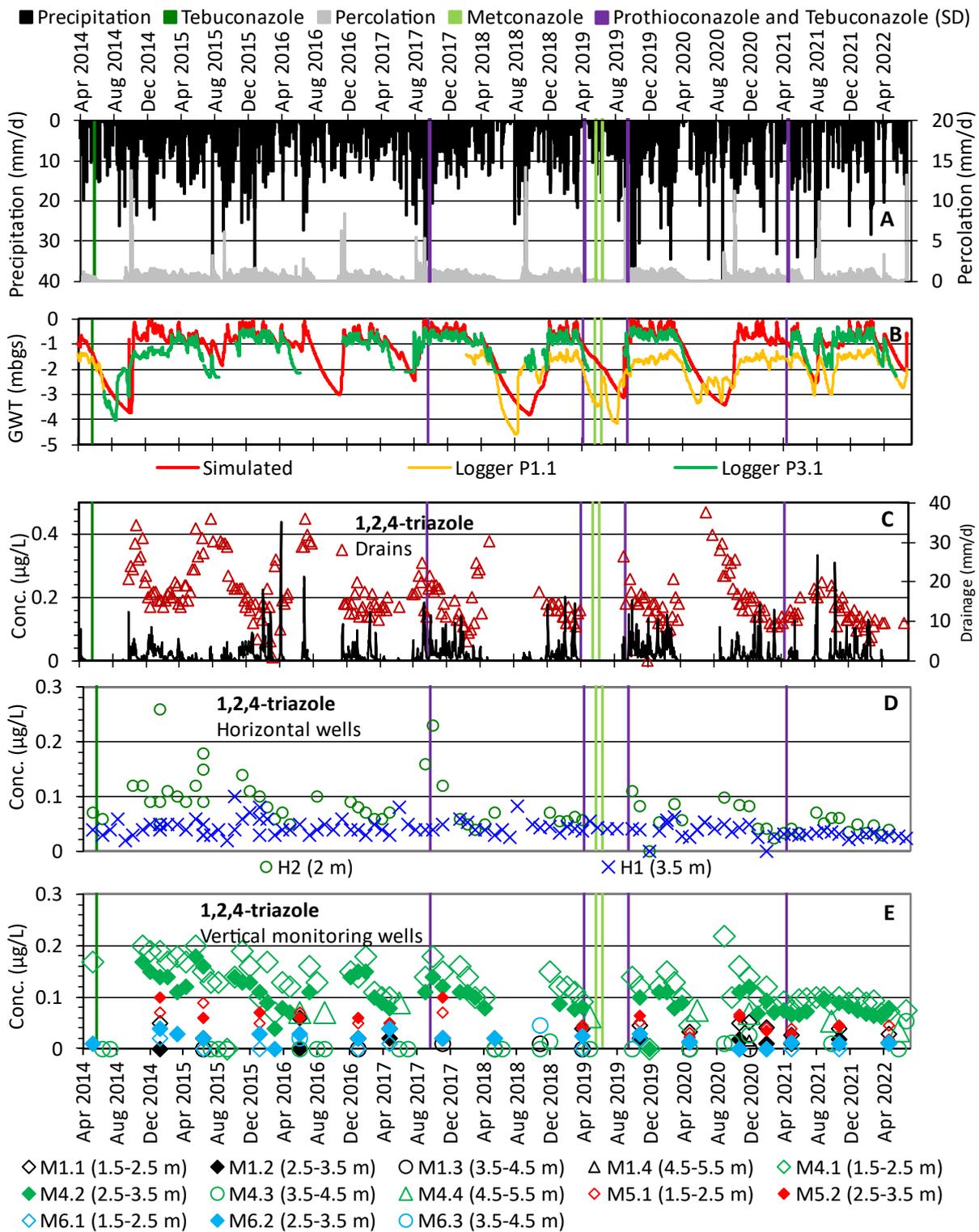


Figure 6.4.3. 1,2,4-triazole monitoring at Estrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); 1,2,4-triazole measured in the variably saturated zone (C); and in horizontal wells H1 and H2 (D) and vertical groundwater monitoring wells, M1, M4, M5, and M6 (E). It is noted that M1 is regarded as an upstream monitoring well. The secondary y-axis (plot C) represents the drainage flow. The vertical coloured lines indicate the date of azole applications. Note that the evaluated results cover April 2019-June 2022. SD, azoles applied as seed dressing (purple lines). Monitoring of 1,2,4-triazole is ongoing.

### Faarstrup

At Faarstrup, 1,2,4-triazole was included in the monitoring in 2014 and the results up to July 2020 are detailed in Badawi *et al.* (2022). The most recent application of an azole product in Faarstrup before the current reporting of July 2020-June 2022 was a split application of propiconazole initiated on June 19, 2017 (Figure 6.4.4). As such, the current evaluation from the 1,2,4-triazole monitoring cover June 2017-June 2022.

### Variably saturated zone monitoring

In the drainage, 1,2,4-triazole detections are observed in concentrations  $> 0.1 \mu\text{g/L}$  in October 2017, March-April 2019, and January-February 2022 with a maximum concentration of  $0.2 \mu\text{g/L}$ . Except for two samples with no detections, 1,2,4-triazole was detected in concentrations  $< 0.1 \mu\text{g/L}$  in all remaining samples (Figure 6.4.4C).

### Groundwater monitoring wells

From June 2017 to June 2022, the downstream wells M4 and M5, and the horizontal well H3 showed 1,2,4-triazole occasional detections in concentrations  $< 0.1 \mu\text{g/L}$  (Figure 6.4.4D) Still, most samples 78 of 90 samples in M4, 79 of 80 samples in M5, and 10 of 15 samples in H3 showed no detections of 1,2,4-triazole throughout the monitoring period (Figure 6.4.4D).

In the upstream groundwater monitoring well M2, no 1,2,4-triazole detections were made in the 14 samples collected (Figure 6.4.4D).

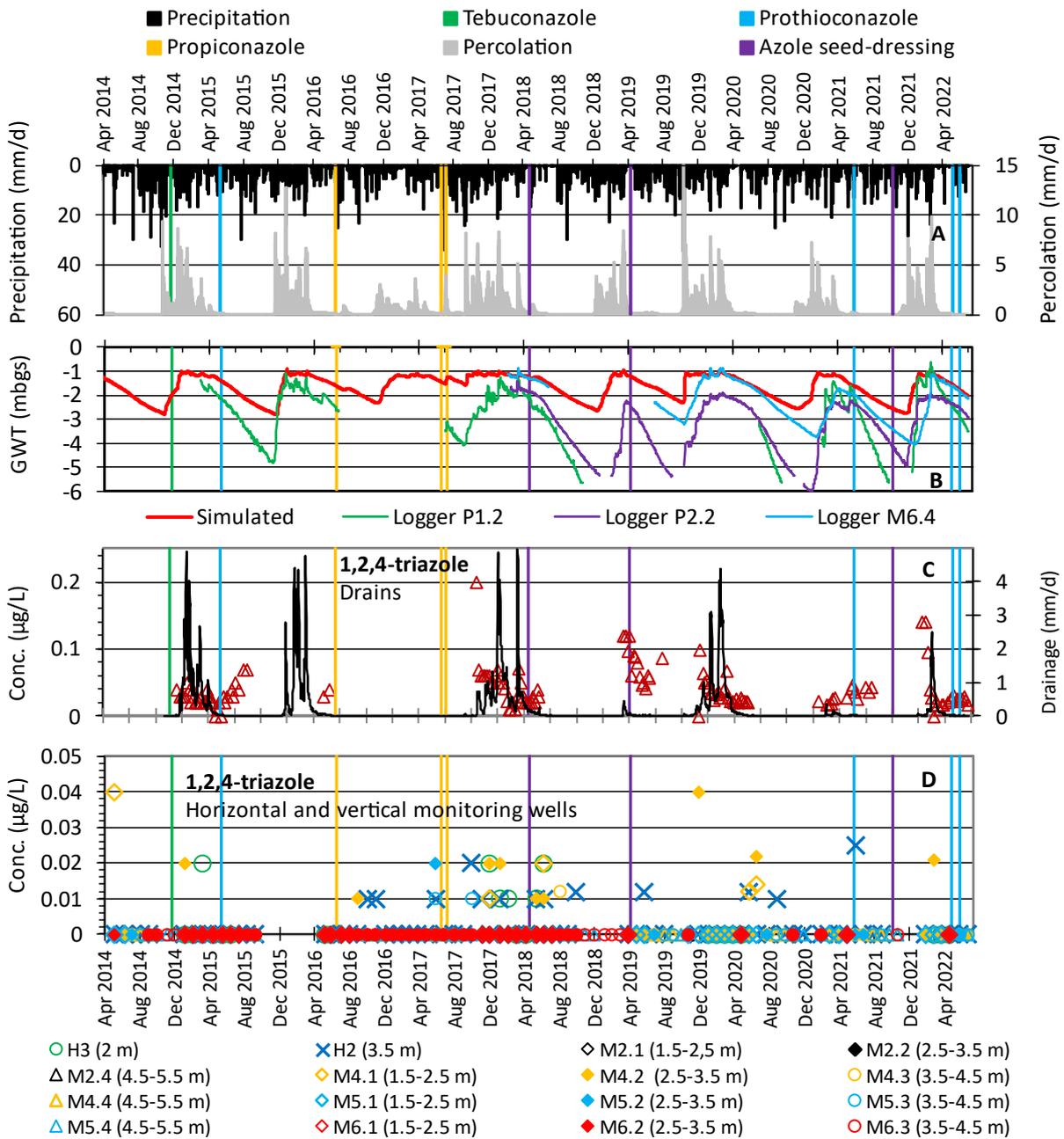


Figure 6.4.4. 1,2,4-triazole monitoring at Faardrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); 1,2,4-triazole measured in the variably saturated zone (C); and in horizontal wells H1 and H3, and vertical groundwater monitoring wells, M2, M4, M5, and M6 (D). It is noted that M2 is regarded as an upstream monitoring well. The secondary y-axis (plot C) represents the drainage flow. The vertical coloured lines indicate the date of azole applications. Note that the evaluated results cover June 2017-June 2022. SD, azoles applied as seed dressing (purple lines). Monitoring of 1,2,4-triazole is ongoing.

### Lund

At Lund, 1,2,4-triazole was included in the monitoring in 2018 and evaluation of the results up to July 2020 are detailed in Badawi *et al.* (2022). The most recent application of an azole product in Lund before the current reporting of July 2020-June 2022 was a split application of prothioconazole initiated on May 30, 2018 (Figure 6.4.5). As such, the current evaluation from the 1,2,4-triazole monitoring cover May 2018-June 2022.

#### *Variably saturated zone monitoring*

1,2,4-triazole is detected in concentrations < 0.1 µg/L in all drainage samples during the monitoring period from May 2018 to June 2022, except in three samples, which was a non-detect (Figure 6.4.5C). It is noted, however, that 1,2,4-triazole was detected in drainage before the first spraying application in May 2018 and registration of seed dressings. As azole fungicides are applied to the field before the 1,2,4-triazole monitoring was started these detections are, however, expected.

#### *Groundwater monitoring wells*

The downstream monitoring wells, M2, M3, M6, and M7 were not sampled at the same frequency or duration as the downstream wells M4 and M5. Sampling in M2 and M7 ended in November 2018, while the latest sampling in M6 was performed in May 2022, although at an irregular frequency (Figure 6.4.5D). All 1,2,4-triazole detections in M2, M3, M6, and M7 were in concentrations < 0.1 µg/L and most of the samples from M6 were non-detects (21 of 29 samples).

The downstream wells, M4 and M5 generally showed 1,2,4-triazole detections in concentrations < 0.1 µg/L throughout the monitoring period with general concentration levels being higher in M5 relative to M4 (figure 6.4.5E). Further, in M5, two detections in concentrations > 0.1 µg/L were made in June 2018 and July 2020. For all the downstream wells except M7, it is noted that 1,2,4-triazole detections were made before the first spraying application and registration of seed dressing, but as azole fungicides are applied to the field before the 1,2,4-triazole monitoring was started these detections are, however, expected.

In the upstream well, M1, 1,2,4-triazole was also detected throughout the monitoring period, and similar to the other wells, 1,2,4-triazole detections were made before the first spraying application and registration of seed dressing (Figure 6.4.5F). All detections in the upstream well were in concentrations < 0.1 µg/L.

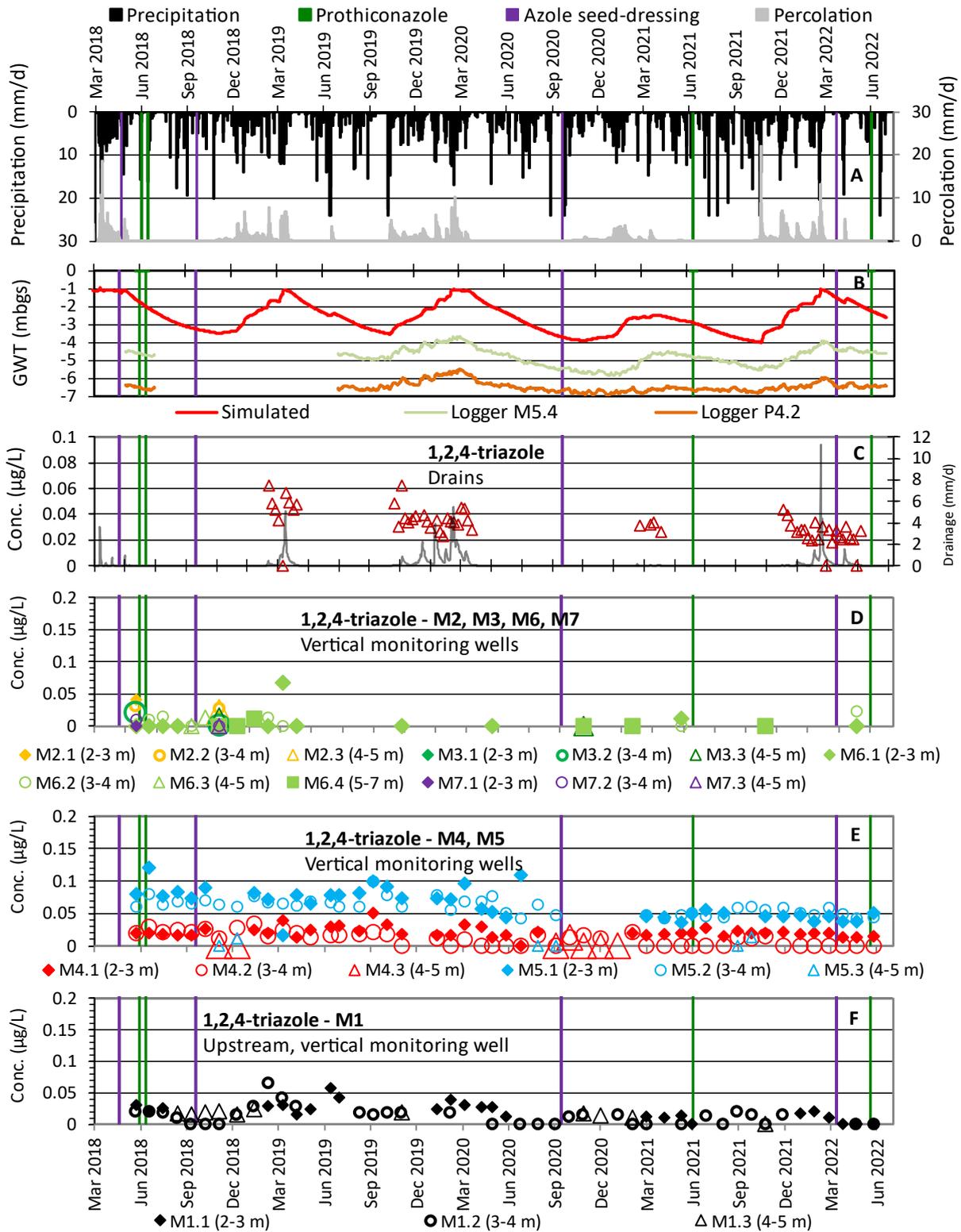


Figure 6.4.5. 1,2,4-triazole monitoring at Lund. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); 1,2,4-triazole measured in the variably saturated zone (C); and vertical groundwater monitoring wells, M2, M3, M6, M7 (D), and M4 and M5 (E), and M1 (F). It is noted that M1 is regarded as an upstream monitoring well. The secondary y-axis (plot C) represents the drainage flow. The vertical coloured lines indicate the date of azole applications. Note that the evaluated results cover May 2018-June 2022. SD, azoles applied as seed dressing (purple lines). Monitoring of 1,2,4-triazole is ongoing.

#### 6.3.4 Discussion and conclusion of the 1,2,4-triazole and metconazole monitoring

As reported in the previous report (Badawi *et al.* 2022), azoles were applied in the fields multiple times since 1999, and in addition to these azole applications, azole-coated seeds were also frequently used. Both types of applications will contribute to the azole soil content and potentially 1,2,4-triazole leaching (Albers *et al.*, 2022). Although azoles were used since 1999, 1,2,4-triazole was not included in the monitoring until 2014, when awareness of the degradation product rose, and the analytical method was first available. Therefore, it was not possible to determine the background content of 1,2,4-triazole in any of the fields before 1,2,4-triazole monitoring was started. Also, the use of azole-coated seeds was registered from 2017 and onwards, but they were most likely used before this time. As mentioned, e.g., in the EFSA conclusion on tebuconazole (EFSA, 2014), azoles are known to accumulate in the plough layer, therefore the presence of accumulated azoles in the PLAP fields is highly likely, and maybe the cause of continuous degradation of azoles into 1,2,4-triazole leading to long-term leaching to the groundwater. As 1,2,4-triazole is a common degradation product of azoles, the origin of 1,2,4-triazole cannot be determined, especially, when several azoles have been used and possibly accumulated, as is the case in the PLAP fields. This means the leaching of 1,2,4-triazole from all PLAP fields cannot be coupled to current sprayings and application of azole-dressed sowing seeds or directly related to past applications of azoles. However, the leaching of 1,2,4-triazole can be linked to the application of azoles in the fields. To discern between the different azole applications and leaching of 1,2,4-triazole, detailed fate studies of azoles in soil are needed. All azole applications including the known use of azole-coated seeds are reported in Appendix 3 and previous PLAP reports are available at [www.plap.dk](http://www.plap.dk).

##### *Variably saturated zone*

Leaching of 1,2,4-triazole to the variably saturated zone is assessed from the monitoring in the suction cups and drainage from sand and clay-till fields, respectively. At the sandy field Jyndevad the relatively high number of detections at 1 m depth in S2 approximately two years from the latest propiconazole application in June 2016 support that 1,2,4-triazole is continuously formed in the topsoil. However, it is noted that these consistent detections were not seen in 1 m depth at S1, where no detections > 0.1 µg/L were found. Nevertheless, the detections in the suction cups in 1 mbgs are likely representative of leaching from the field itself as the depth to the groundwater table is rarely less than 1 m (Figure 3.2, Badawi *et al.*, 2022). Detections of 1,2,4-triazole were continuous although decreasing throughout the monitoring period, thus, supporting that 1,2,4-triazole is consistently present in the variably saturated zone and leached when drainage is present. This corroborates with the findings of Albers *et al.* (2022) and the EFSA conclusion on tebuconazole stating possible azole accumulation in the plough layer (EFSA, 2014).

At all the clay till fields (viz. Silstrup, Estrup, Faardrup, and Lund), 1,2,4-triazole detections in drainage were made throughout the monitoring period, though the detected concentrations varied considerably between the fields. In Lund, none of the detections exceeded 0.1 µg/L (Figure 6.4.5C), whereas in Silstrup and Faardrup some detections exceeded 0.1 µg/L (Table 6.4.1; Figure 6.4.2C and Figure 6.4.4C), and in Estrup all detections were > 0.1 µg/L (Figure 6.4.3C). Hence, some fields seem more prone to leach 1,2,4-triazole in higher concentrations, which is also observed in the measured concentrations from the groundwater monitoring wells as described below. As such, high drainage concentrations were followed by relatively high detections in the groundwater monitoring wells and vice versa. For instance, in Estrup, where the highest 1,2,4-triazole concentrations (of around 0.4 µg/L) were detected in drainage (Figure 6.4.3C), correspondingly high concentrations (up to around 0.2 µg/L) were detected in the groundwater (Figure 6.4.3D). In contrast, at Silstrup where the highest 1,2,4-triazole concentrations (up to around 0.2 µg/L) occurred only twice in drainage (Figure 6.4.2C), correspondingly low concentrations (commonly < 0.05 µg/L) were detected in groundwater (Figure 6.4.2D and E). Therefore, based on these measurements it seems plausible that the

1,2,4-triazole drainage concentrations levels serve as a proxy for 1,2,4-triazole concentration levels in groundwater.

#### *Groundwater monitoring*

Leaching of 1,2,4-triazole at Jyndevad to the groundwater was confirmed and showed consistent detections in the downstream wells M1 and M2. During approximately one year (November 2018 - November 2019) with quarterly sampling, increasing detections > 0.1 µg/L were made in the downstream well M2 (Figure 6.4.1D), while none of the remaining downstream wells had detections exceeding the limit value. Subsequently, two periods with increasing concentrations in M2 (below the limit value) started in August 2020 and May 2021, while such patterns were not observed in the remaining downstream wells. However, it is noted that in the upstream well, M7, the time of maximum concentrations coincided with the detection of the maximum concentration in M2 (Figure 6.4.1D and F). Similarly, the upstream well also showed periods of increasing concentration coinciding with the detected increase in 1,2,4-triazole in M2. It is unlikely that these detections in M7 stem from the 1,2,4-triazole application on the Jyndevad field, as the M7 well location is upstream meaning that groundwater flowing towards M7 originates east of the field (see Figure 2.1.1, Jyndevad in Chapter 2). Therefore, an explanation for the similarities in the leaching patterns between the upstream and downstream wells is likely related to azoles being bound in the variably saturated zone for relatively long periods. If azole products were used in sprayings or seed coatings at upstream fields, 1,2,4-triazole is likely formed from degradation of the azole fungicides in the topsoil as observed at the Jyndevad field.

At the clay till fields, the leaching pattern from each of the fields differed in terms of detected concentration levels in the groundwater monitoring wells. As discussed above concerning the detections in the drainage, high drainage concentrations were followed by relatively high detections in the groundwater monitoring wells and vice versa. Nevertheless, in contrast to the sandy field, where detected concentration levels decreased over time in the variably saturated zone, 1,2,4-triazole concentration levels in drainage of the clay till fields persisted (e.g., Figure 6.4.2C and D). The reason for consistent leaching to drainage and groundwater is likely related to 1,2,4-triazole being formed in the topsoil from accumulated azoles. At Lund, the upstream well M1 showed continuous detections (Figure 6.4.5F) as observed in the upstream well at Jyndevad. Hence, similar to Jyndevad, these detections in the upstream well of Lund may be related to azoles being bound for a relatively long time in the topsoil. However, monitoring of picloram (section 6.11) and propyzamide (section 6.12) also showed detections in the upstream well M1 at Lund. Therefore, it cannot be readily inferred why 1,2,4-triazole occurred in M1.

Generally, in periods with drainage flow and detections of 1,2,4-triazole in drainage, 1,2,4-triazole is also observed in groundwater. As such, 1,2,4-triazole concentration levels exceeding the limit value at Estrup in groundwater downstream of the field are measured throughout the monitoring period in periods with drainage flow. Similarly, at Silstrup, 1,2,4-triazole detections, although below the limit value, in the groundwater coincide with drainage detections.

Metconazole was monitored at Estrup, after a split application in spring barley in 2019 and was not detected in drainage or groundwater in the period before the applications. It was detected once in a drainage sample but not in the groundwater during the monitoring period from May 2019 to March 2021, when the monitoring ended.

## 6.4 Azoxystrobin test

CyPM is monitored in the current monitoring period, July 2020-June 2022, following azoxystrobin application at the clay till field, Silstrup. Detailed information on the Silstrup field site is available in Chapter 2.

### 6.4.1 Application of azoxystrobin at Silstrup

Azoxystrobin was tested in PLAP in connection with cropping of winter wheat 2020, and azoxystrobin was applied twice, on May 28 and June 16, 2020. Detailed information on agricultural management is available in Chapter 3, Appendix 3 and previous PLAP reports.

Azoxystrobin was previously applied five times on the Silstrup field site (2004, 2005, 2009, 2013, 2014), twice in Tylstrup (2008, 2009), three times at Jyndevad (2005, 2008, 2010), six times at Estrup (2004, 2006, 2008, 2009, 2012, 2014), three times at Faardrup (2004, 2010, 2014), and once at Lund (2017). The results from the previous azoxystrobin applications are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk).

### 6.4.2 Compounds included in the monitoring

The major and relevant degradation product CypM (EFSA 2010) was selected for monitoring and included in the monitoring in May 2020. For additional information on CypM refer to Appendix 1. Monitoring of CyPM is ongoing.

### 6.4.3 Results of the CyPM monitoring at Silstrup

The day before the first azoxystrobin application on May 28, 2020, background samples were collected in the horizontal well and the monitoring wells. In total, four samples were collected and none of these contained CyPM.

An overview of the entire monitoring is given in Table 6.5.1 and shows the number of detections for each monitoring intake after the first azoxystrobin application on May 28, 2020, and to the end of the reporting period on June 30, 2022.

*Table 6.5.1. Number of samples and detections of CyPM at Silstrup in drainage (D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from May 28, 2020, to June 30, 2022. Background samples collected before the application of azoxystrobin are not included in the counting.*

	Total			D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	N	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Silstrup</b>															
<b>CyPM</b>	201	76	12	50	40	9	106	22	2	45	14	1	151	36	3

#### *Variably saturated zone monitoring*

Analyses from the drainage show that CyPM was detected for the first time in October 2020, corresponding to 5 months after the first azoxystrobin application in May 2020 (Figure 6.5.1C). The detections are relatively consistent (40 out of 50 samples) throughout the monitoring period. The maximum CyPM concentration of 0.21 µg/L is detected in October 2020, and concentrations > 0.1 µg/L are generally observed from October 2020 to April 2021, corresponding to six months. From May 2021 to the latest detections in April 2022, the detections are consistently < 0.1 µg/L.

### *Groundwater monitoring wells*

It is noted that not all groundwater monitoring wells are actively monitored due to budget limitations, and neither is each of the intakes in the wells selected for monitoring. For the current report, the vertical monitoring wells M5, M9, M10, and M12 were sampled (in the two uppermost waterfilled screens), and horizontal well H1 and H3 was monitored.

### *Well H1 and H3*

Monthly groundwater samples from the horizontal well, H1 and H3, both show CyPM detections in October 2020 which corresponded to the maximum observed concentrations of 0.11 and 0.073 µg/L, respectively (Figure 6.5.1D). Subsequently, there were no detections with concentrations exceeding the limit value and from June 2021 to the latest sampling in June 2022, none of the groundwater samples contained CyPM.

### *Well M5*

The first detections of CyPM in M5 are found in October 2020, a few weeks after the detection of CyPM in drainage and 5 months after application of azoxystrobin. Further, the concentrations are the highest observed in groundwater monitoring wells and also exceed the limit value with concentrations of 0.19 and 0.23 µg/L. (Figure 6.5.1E). From December 2020 until the last sampling in June 2022, all measured concentrations were < 0.1 µg/L. There were no detections from April 2021 and onwards except on two occasions in June 2021 and March 2022, where concentrations did not exceed 0.016 µg/L (Figure 6.5.1E).

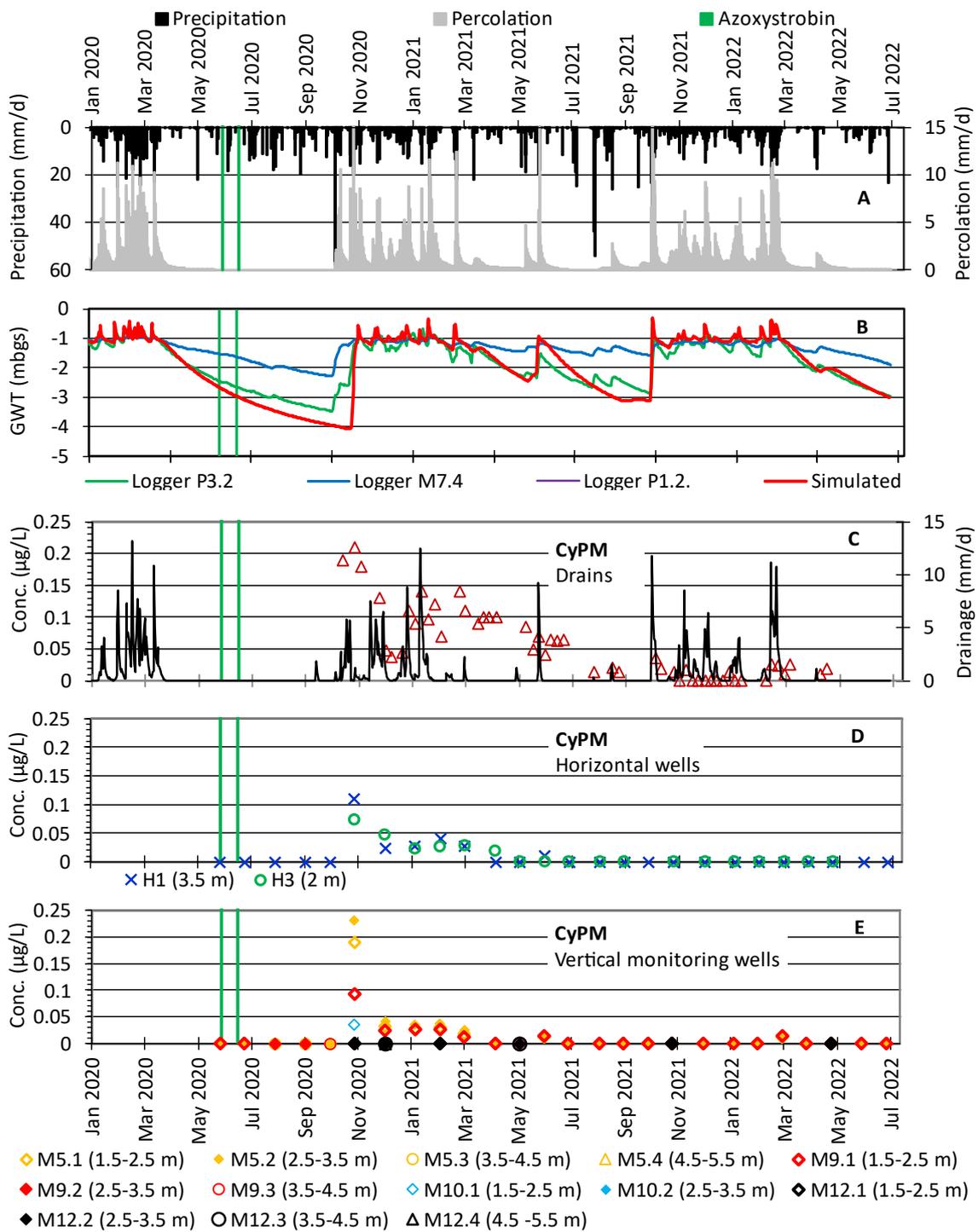


Figure 6.5.1. CyPM monitoring at Silstrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); CyPM measured in the variably saturated zone (C); groundwater in horizontal wells (D); and vertical wells (E). The secondary y-axis (plot C) represents the drainage flow. It is noted that M12 is regarded as an upstream monitoring well. The vertical green lines indicate the date of azoxystrobin applications. CyPM was included in the monitoring in May 2020 as part of the 2021 azoxystrobin test initiated in May 2020. Monitoring of CyPM at Silstrup is ongoing.

#### *Well M9*

Groundwater samples from well M9 showed CyPM concentrations exceeding the limit value in one sample five months (October 2020) after the first azoxystrobin application in May 2020 (Figure 6.5.1E). This detection, which was the first of CyPM in groundwater corresponded to the maximum concentration (0.092 µg/L) observed in well M9 during the monitoring period. From December 2020 until the last sampling in June 2022, the detections in well M9 were similar to what is observed in well M5. That is, all measured concentrations were < 0.1 µg/L while there were no detections of CyPM in samples from April 2021 and onwards, except on two occasions in June 2021 and March 2022. Here, the concentrations did not exceed 0.015 µg/L (Figure 6.5.1E).

#### *Well M10*

In well M10, groundwater sampling differs from wells M5 and M9 as the sampling frequency was lower. Well M10 is sampled in varying intervals ranging from quarterly to half-yearly. During the entire monitoring period, CyPM was detected once (October 2020) five months after the first azoxystrobin application in May 2020 (Figure 6.5.1E) in a concentration < 0.1 µg/L.

#### *Well M12*

In upstream well M12, the groundwater sampling also differs from wells M5 and M9 in that the sampling frequency was less. Well M12 is sampled in varying intervals ranging from quarterly to half-yearly. No detections of CyPM are observed during the entire monitoring period (Figure 6.5.1E).

### 6.4.4 Discussion and conclusion on the CyPM monitoring at the Silstrup field

The occurrence of the maximum CyPM concentration in all the monitoring wells was in October 2020 corresponding to 5 months after the first azoxystrobin application. The exceedance of the limit value observed in wells M5, H1, and H3 was also observed in October 2020 after which no detections of CyPM concentrations > 0.1 µg/L occurred. A similar pattern is observed in the maximum drainage concentration which coincides with the maximum concentrations observed in the groundwater wells (Figure 6.5.1). The overall leaching pattern of CyPM is similar in drainage and groundwater samples, with relatively high concentrations found 5 months after azoxystrobin application and following the first major drainage event. The subsequent slow decrease in concentration seen in drainage samples, however, does not correspond to the pattern seen in groundwater samples, as the concentrations here decline rapidly and continue to be far below the limit value for the rest of the monitoring period. This indicates that CyPM, although detectable in the drainage does not leach to the groundwater, perhaps due to further degradation. A total of 201 samples were collected in drainage and groundwater during the azoxystrobin test at Silstrup. CyPM was detected in 76 of these and in 12 samples in concentrations > 0.1 µg/L. The CyPM detections > 0.1 µg/L were found in nine drainage samples out of 50 drainage samples and in three out of 151 groundwater samples.

## 6.5 Cyazofamid test

This chapter is structurally different from the rest of the pesticide test chapters, as it encompasses the translated extraordinary PLAP report published in January 2023. The extraordinary PLAP report included laboratory batch- and column experiments in addition to the monitoring data, but these data are not included here as these were done as part of a specific research project and not in relation to PLAP. The extraordinary report was published in Danish and is available at [www.plap.dk](http://www.plap.dk).

The four degradation products, CTCA, CCIM, DMS, and DMSA were monitored during the current monitoring period, July 2020-June 2022, following cyazofamid application in PLAP at the sandy field, Jyndeved. Detailed information on the field site is available in Chapter 2.

### 6.5.1 Application of cyazofamid at Jyndeved

Cyazofamid has been tested in PLAP in connection with potato cultivation three times on the Jyndeved field site, viz., in 2010, 2014, and 2020. The results from the 2010 and 2014 cyazofamid applications are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk). In 2020, cyazofamid was applied six times from June 14 to September 10, with 0.5 L/ha Ranman Top (160 g/L cyazofamid, reg. nr. 352-8). It is noted that in the previous PLAP report (Badawi *et al.*, 2022), cyazofamid was erroneously specified as being applied seven times. Cyazofamid was applied six times in accordance with the regulation (Chapter 3).

The spray solutions applied in the fields were, as common practice in PLAP, analysed for the content of the active ingredient included in the test. The six spray solutions used at Jyndeved in 2020 contained cyazofamid in the range of 220-330 mg/L (% CV from the nominal concentration was  $\pm 17-24$  %) (Badawi *et al.* 2023). Previously, no degradation products were analysed in the spray solutions, but as the monitoring results from the suction cups suggested DMSA as being produced already in the spray solution even before application, degradation products were introduced in the analyses. Therefore, an additional spray solution prepared similar to the six used in the field, was prepared on June 22, 2022, and analysed for the content of cyazofamid and the four degradation products, DMS, DMSA, CCIM, and CTCA. The results from the analysis showed that in addition to cyazofamid, both CCIM and DMSA were present in the solution before application (Table 6.6.1). The concentration of cyazofamid in this spray solution was 290 mg/L, which was similar to the content of cyazofamid in the previous six spray solutions applied in the field. The additional spray solution is therefore considered representative of the spray solutions used in the cyazofamid test.

*Table 6.6.1. Content of the active ingredient, cyazofamid, and the degradation products, DMS, DMSA, CCIM, and CTCA in the spray solution from June 22, 2022. The spray solution was only prepared with the purpose of analysing the content of the five compounds and was not applied in the field. The concentration is converted to millimolar (mM) and the content of CCIM and DMSA as a percentage of cyazofamid content is calculated (%mM). The original content of cyazofamid is calculated as the sum of cyazofamid and CCIM and is used for calculating the percentage of DMSA and CCIM.*

Compound	µg/L	g/L	g/mole	mol/L	mM	% µg/L	% mM
Cyazofamid	290,000	0.29	324.8	0.00089	0.89	-	-
CCIM	43,500	0.0435	215.7	0.00020	0.20	13.0	18.4
DMSA	4,340	0.00434	125.2	0.00003	0.03	1.3	3.2
CTCA	< 100*	< 0.1	236.7	-	-	-	-
DMS	< 100*	< 0.1	124.2	-	-	-	-

\* Detection limit (DL) is noted as < 100 µg/L in the non-diluted spray solution, which is equal to a DL of 0.01 µ/L in the diluted sample used for analysis (dilution factor 10.000).

## 6.5.2 Compounds included in the monitoring

The EFSA conclusion on cyazofamid defines the degradation products CTCA and CCIM as major metabolites (EFSA, 2020) and these were included in the monitoring. In addition, DMS and DMSA were included in the monitoring. DMS is not mentioned as a metabolite of cyazofamid in the EFSA conclusion (EFSA, 2020) but in 2019 an ongoing research project, Fungisource (funded by Bekæmpelsesmiddelpuljen, DEPA), detected relatively low concentrations of DMS in groundwater from the Jynde vad field. Therefore, DMS was also selected for monitoring. DMSA is mentioned in the EFSA conclusion on cyazofamid in connection with acute oral toxicity- and an *in vitro* bacterial mutation test, where its toxicity was tested (EFSA, 2020). I.e., DMSA is not mentioned as a metabolite of cyazofamid but, as it is suspected to be a hydrolysis product from hydrolysis of cyazofamid to CCIM (Figure 6.6.1), DMSA was included in the monitoring. Hence, in the monitoring period from June 2020 to June 2022, the four degradation products; CTCA, CCIM, DMS, and DMSA were analysed in suction cups and groundwater samples at the Jynde vad field. Cyazofamid was not part of the monitoring. Monitoring of the four degradation products is still ongoing.

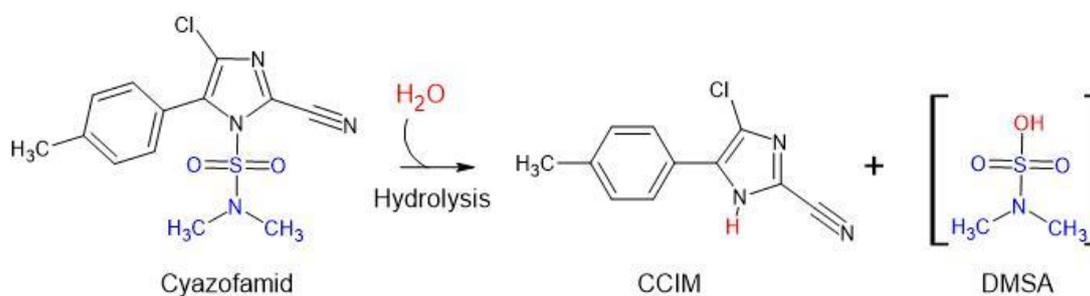


Figure 6.6.1 Proposed hydrolytic reaction scheme of cyazofamid and formation of hydrolysis products, CCIM and DMSA. Only CCIM is noted as a hydrolysis product from cyazofamid in the EFSA conclusion on cyazofamid (EFSA 2020). Both compounds were present in the aqueous cyazofamid spray solution before application in the field (table 1).

Monitoring of the four degradation products was planned to start in April 2020, but the analytical methods for analyses of CTCA, CCIM, DMS, and DMSA were not available at that time. Consequently, the water samples collected in the period from April to October 2020 were stored at -20°C before analytical methods for CCIM, CTCA, and DMSA were ready. The analytical method for analysis of DMS was ready after 14 days of storage at -20°C (refer to Chapter 7). The effect of storing the samples is currently unknown but, relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). In the following, it is clearly stated which samples were stored, and overall, merely 65 of 265 samples were stored before analyses of DMSA, CCIM, and CTCA, and nine of 265 samples were stored before analysis of DMS.

## 6.5.3 Results of CTCA, CCIM, DMS, and DMSA monitoring at Jynde vad

Before the first cyazofamid application on June 14, 2020, 31 background samples were collected in suction cups and groundwater. Three of the 31 background samples contained DMS, all with a concentration < 0.1 µg/L. An overview of the entire monitoring is given in Table 6.6.2. The table shows the number of samples and detections for each monitored degradation product in water from suction cups and groundwater during the monitoring period from June 2020 to June 2022.

Table 6.6.2 gives an overview of the total number of samples, detections, and detections > 0,01 µg/L in the various monitoring devices from the period April 2020 to June 2022. In the suction cups, 234 samples were collected and in these DMS and DMSA were detected in 119 and 71 samples, respectively. Further, DMS and DMSA exceeded the limit value in 56 and 44 samples. In the groundwater intakes, 186 samples were collected

and in these DMS and DMSA were detected in 77 and 60 samples, respectively. Further, DMS and DMSA exceeded the limit value in 43 and 38 groundwater samples. CCIM and CTCA were not found in any of the samples.

Table 6.6.2. Number of samples and detections of DMS, DMSA, CCIM, and CTCA at Jynde vad in water from suction cups (S), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from June 14, 2020, to June 30, 2022. Background samples collected before the application of cyazofamid are not included in the counting.

Jynde vad	Total			S			M			H			Total (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
DMS	234	119	56	48	42	13	173	65	36	13	12	7	186	77	43
DMSA	234	71	44	48	11	6	173	56	35	13	4	3	186	60	38
CCIM	234	0	0	48	0	0	173	0	0	13	0	0	186	0	0
CTCA	234	0	0	48	0	0	173	0	0	13	0	0	186	0	0

#### Variably saturated zone monitoring

Analyses from the suction cups in 1 mbgs show that DMS was detected in August and September 2020, corresponding to 2-3 months after the first cyazofamid application in June 2020. Subsequently, increasing DMS concentrations were generally measured until December 2020, after which the concentrations decreased (Figure 6.6.2C). Relatively high concentrations (> 0.1 µg/L) are measured, with maximum concentrations up to approximately 0.4 µg/L from August 2020 to April 2021. After April 2021, concentrations decreased to levels < 0.1 µg/L and continued to decrease towards the last sampling event in June 2022.

DMSA analyses from the suction cups show the first detections in August and October 2020, corresponding to 2–4 months after the first cyazofamid application in June 2020 (Figure 6.6.2D). In contrast to the DMS concentrations, there is no clear increase in DMSA concentration over several months, but the maximum DMSA concentrations are substantially higher. The maximum DMSA concentration of 2.1 µg/L in S2 is approximately a factor of 5 higher than the maximum measured DMS concentration in the suction cups. After November 2020, DMSA is detected a few times in concentrations < 0.1 µg/L towards the last sampling event in June 2022.

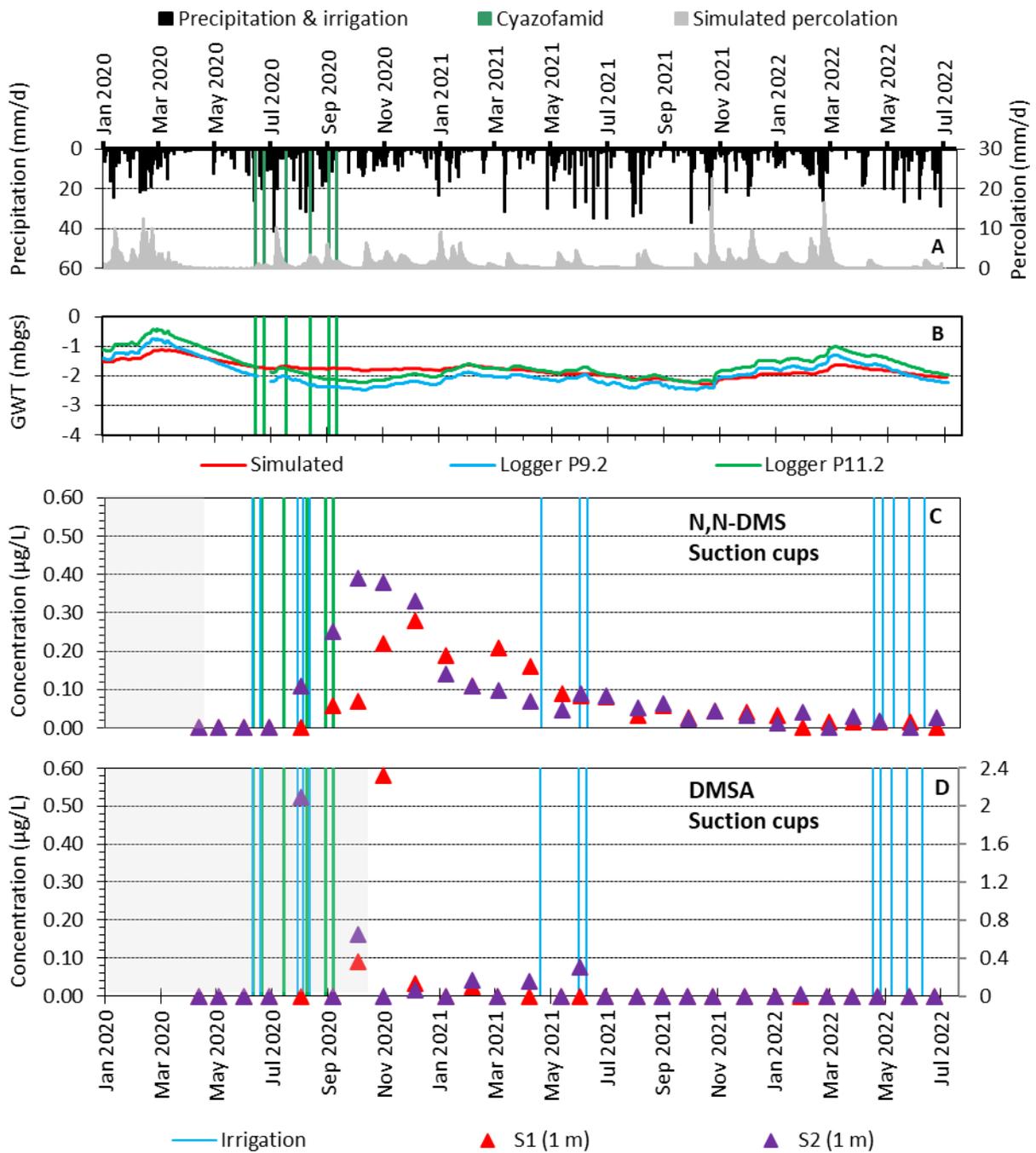


Figure 6.6.2. DMS and DMSA monitoring in suction cups at Jyndevad. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); measured DMS (C) and DMSA (D) in the variably saturated zone. The secondary y-axis represents the percolation (plot A) and DMSA concentrations measured in S2 (plot D, purple triangles), where a maximum concentration of 2.1  $\mu\text{g/L}$  was measured. Gray shaded areas delineate periods, where samples were stored at  $-20^\circ\text{C}$  before analysis. The vertical red and blue lines represent the cyazofamid applications and field irrigations, respectively. Monitoring of DMS and DMSA is ongoing.

### *Groundwater monitoring wells*

It is noted that not all groundwater monitoring wells are actively monitored due to budget limitations, and neither are all screens of the intakes in the wells selected for monitoring. For the current report, intakes in the vertical monitoring wells M1, M2, M4, M5, and M7, and horizontal well H1 are monitored.

#### *Well M1*

Groundwater samples from well M1 show that DMS and DMSA are detected in relatively high concentrations ( $> 0.1 \mu\text{g/L}$ ) with maximum concentrations of  $0.44$  and  $0.38 \mu\text{g/L}$ , respectively (Figure 6.6.3). From June 2021, approximately one year after the first cyazofamid application, DMS is detected for the first time, after which a pulse of DMS with a duration of one year to June 2022 is observed (Figure 6.6.3C). The breakthrough of DMS in concentrations exceeding the limit value of  $0.1 \mu\text{g/L}$  occurred 15 months (in August 2021) after the first cyazofamid application in June 2020. From August 2021, the measured DMS concentrations increased towards the overall maximum around mid-October 2021, whereafter concentrations were decreasing. However, for six months from August 2021 to January 2022, there were constant detections of DMS in concentrations  $> 0.1 \mu\text{g/L}$ , both in intakes M1.2 and M1.3 (Figure 6.6.3C). There are no DMS detections from one-meter depth (intake M1.1) from January 2022 to the latest sampling in June 2022, and the detections from 2 and 3 meters depth (intake M1.2 and M1.3, respectively) are  $< 0.1 \mu\text{g/L}$  in the same period.

The breakthrough of DMSA concentrations exceeding the limit value of  $0.1 \mu\text{g/L}$  occurred approximately one year (June 2021) after the first cyazofamid application in June 2020. Thus, DMSA detections in concentrations above the limit value are detected approximately 3 months earlier compared to the measured DMS concentrations  $> 0.1 \mu\text{g/L}$ . From June 2021, the measured DMSA concentrations increased towards a maximum (of  $0.38 \mu\text{g/L}$ ) in September 2021, after which the concentrations are generally decreasing. Thus, for six months from June to November 2021, there are constant detections of DMSA with concentrations exceeding  $0.1 \mu\text{g/L}$  (Figure 6.6.3B). From December 2021 to the latest sampling event in June 2022, DMSA concentrations are generally decreasing, resulting in zero detections from March 2022 and onwards.

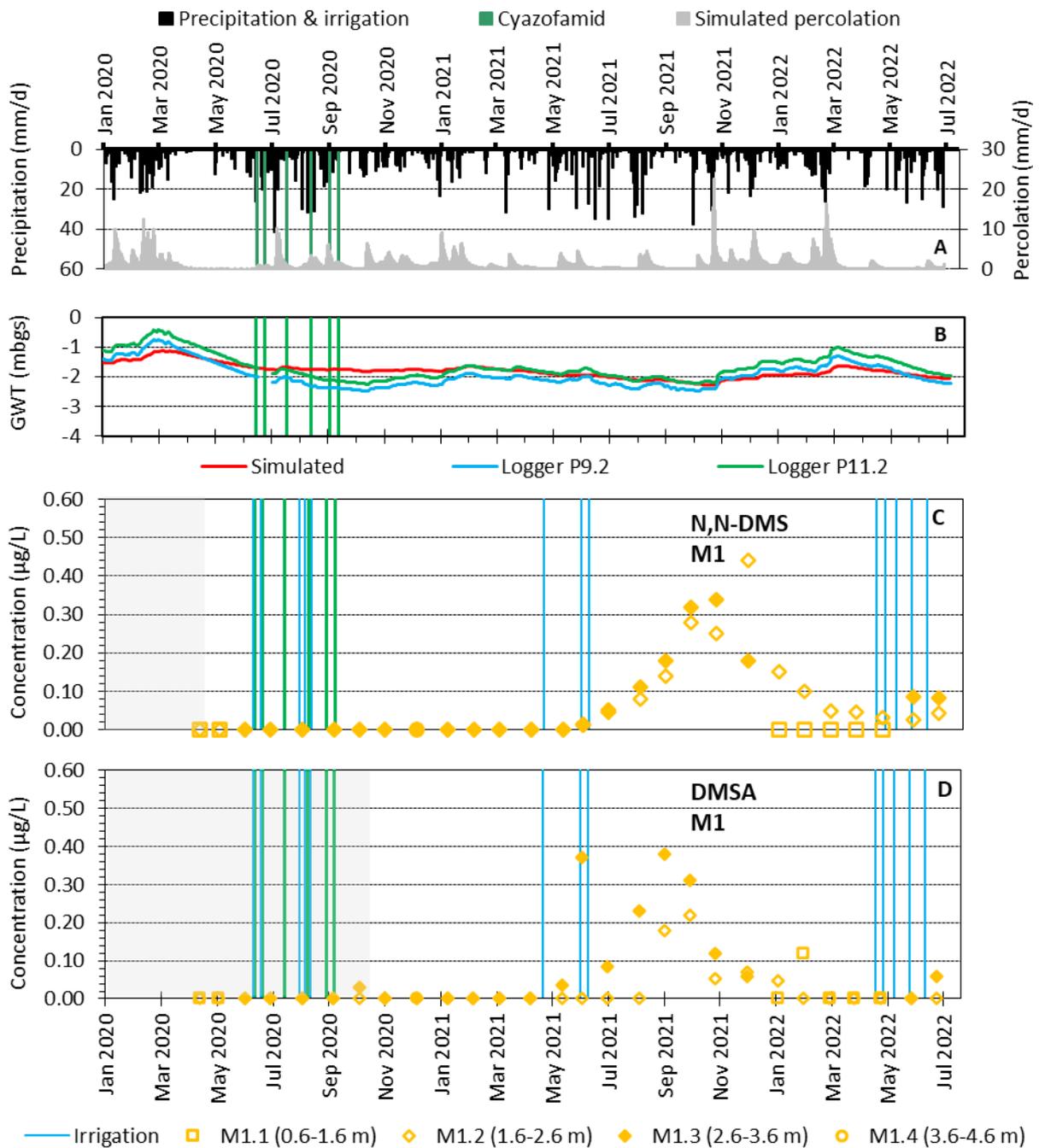


Figure 6.6.3. DMS and DMSA monitoring in well M1 at Jynde vad. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); measured DMS (C) and DMSA (D) in monitoring well M1. The secondary y-axis represents the percolation (A). Gray shaded areas delineate periods, where samples were stored at -20 °C before analysis. The vertical green and blue lines represent the cyazofamid applications and field irrigations, respectively. Monitoring of DMS and DMSA is ongoing.

#### Well M2

Groundwater samples from well M2 show that DMS in concentrations above the limit value is detected in one sample 16 months (November 2021) after the first cyazofamid application in June 2020 (Figure 6.6.4C). The DMS concentration in the sample was 0.15 µg/L. The first detection of DMS occurred in May 2021, approximately one year after the first cyazofamid application, which is also observed in well M1. It is noted that the sampling frequency in well M2 was quarterly in contrast to wells M1, M4, and M7, where samples

are taken monthly. However, based on the quarterly sampling, a pulse of DMS is observed from May 2021 until the latest sampling event in May 2022 (Figure 6.6.4D). The duration of the pulse of DMS in well M2 corresponding to one year is comparable to the observed DMS pulse in well M1 (Figure 6.6.4C).

DMSA was detected in well M2 from May to November 2021 and the maximum concentration of 0.34  $\mu\text{g/L}$  is measured in May 2021. Only in the sample from May 2021, was the limit value of 0.1  $\mu\text{g/L}$  exceeded.

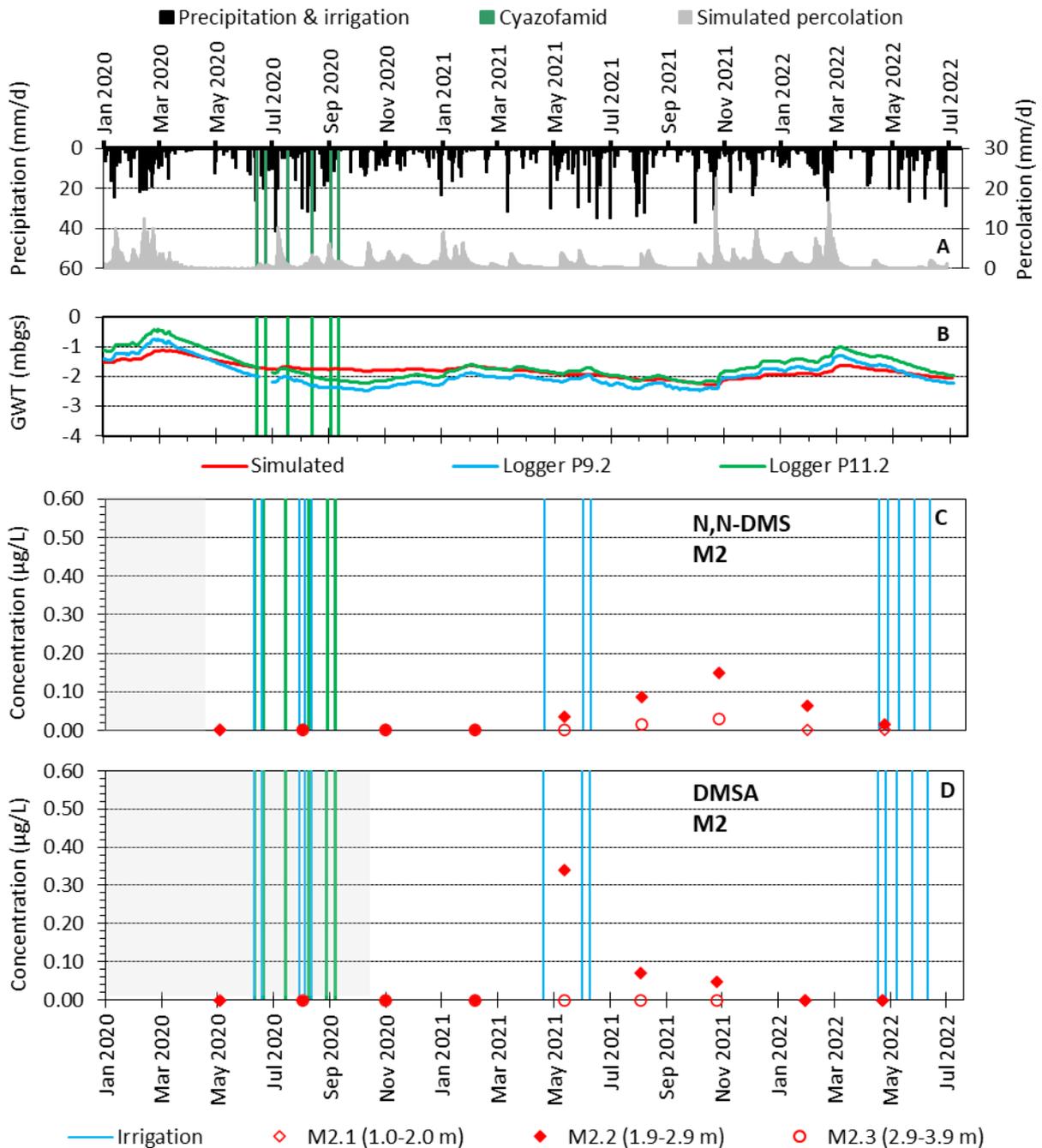


Figure 6.6.4. DMS and DMSA monitoring in well M2 at Jyndevid. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); measured DMS (C) and DMSA (D) in monitoring well M2. The secondary y-axis represents the percolation (A). Gray shaded areas delineate periods, where samples were stored at -20 °C before analysis. The vertical green and blue lines represent the cyazofamid applications and field irrigations, respectively. Monitoring of DMS and DMSA is ongoing.

#### *Well M4*

Groundwater samples from well M4 show that DMS and DMSA are detected in relatively high concentrations ( $> 0.1 \mu\text{g/L}$ ) with maximum concentrations of  $0.29$  and  $0.78 \mu\text{g/L}$ , respectively (Figure 6.6.5). From April 2021 until the latest sampling event in June 2022, DMS is constantly detected (Figure 6.6.5A). The breakthrough of DMS in concentrations exceeding the limit value of  $0.1 \mu\text{g/L}$  occurred 14 months (July 2021) after the first cyazofamid application in June 2020. From July 2021 to June 2022, corresponding to one year, generally, all groundwater samples (22 out of 24) contained DMS concentrations exceeding the limit value. The maximum DMS concentration was detected in February 2022 (Figure 6.6.5A). In contrast to well M1, where a relatively limited pulse of DMS is observed (Figure 6.6.5A), there are not yet clear signs of decreasing concentrations in M4, as the measured concentrations in well M4 vary considerably from January to June 2022 (Figure 6.6.5C).

DMSA is detected in groundwater samples from well M4 in February 2021 after the first cyazofamid application in June 2020. Subsequently, DMSA is detected again in April 2021, after which DMSA is generally detected constantly (27 out of 28 groundwater samples) until the latest sampling event in June 2022. From April 2021 to June 2022, the limit value is exceeded in 18 of 28 analyses (Figure 6.6.5B). In addition, maximum DMSA concentrations are measured in June 2021 and were substantially higher relative to the remaining measurements. From the measured DMSA concentrations, there are not yet signs of decreasing concentrations in M4, as the concentrations are not clearly decreasing from April to June 2022.

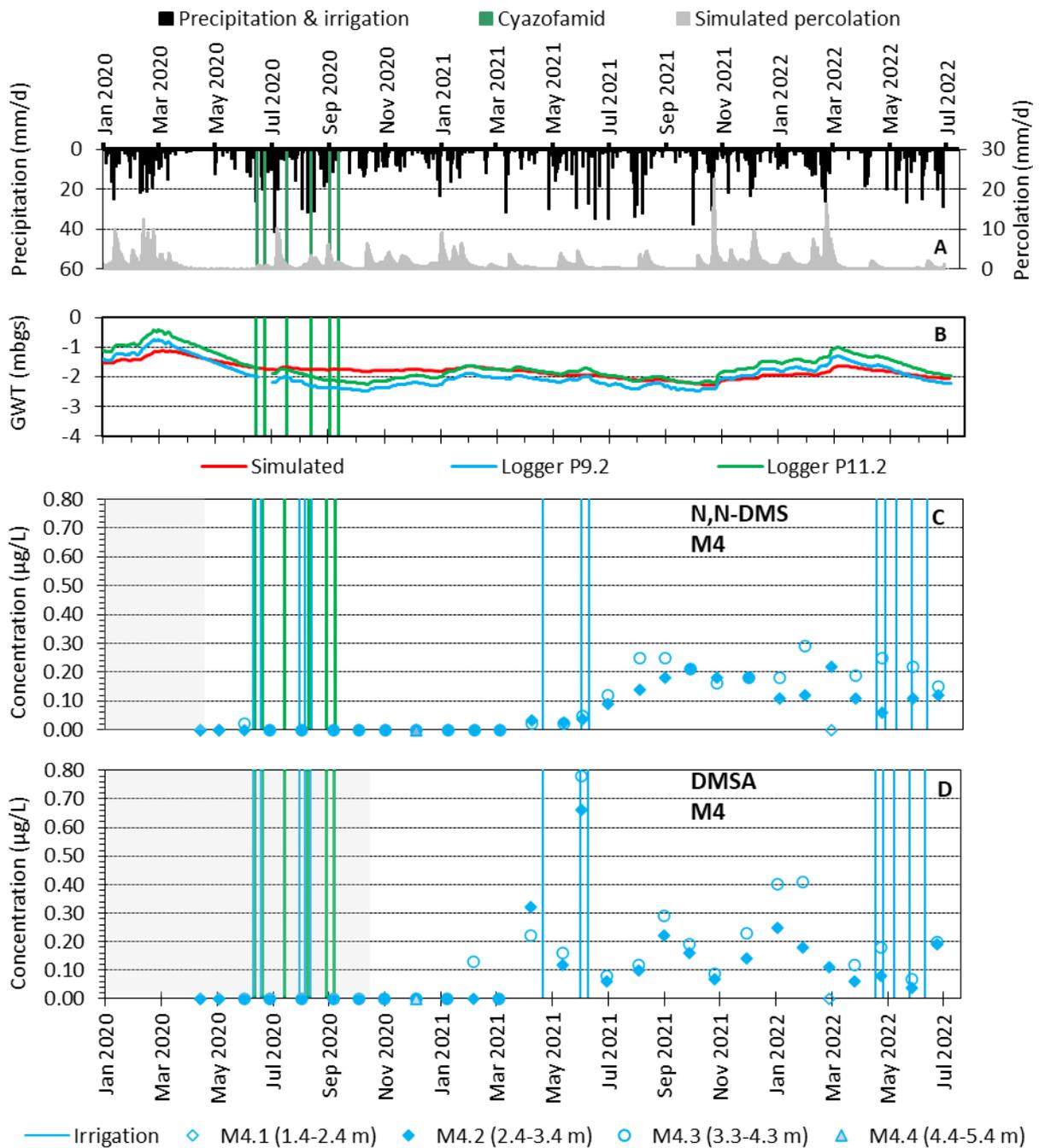


Figure 6.6.5. DMS and DMSA monitoring in well M4 at Jyndeved. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); measured DMS (C) and DMSA (D) in monitoring well M4. The secondary y-axis represents the percolation (A). Gray shaded areas delineate periods, where samples were stored at -20 °C before analysis. The vertical green and blue lines represent the cyazofamid applications and field irrigations, respectively. Monitoring of DMS and DMSA is ongoing.

#### Well H1

Groundwater samples from well H1 were collected at varying intervals, as there was not always water in the well during the monthly sampling. When comparing the measured groundwater level in various observation wells (Figure 6.6.6A) and the collection of water samples for analysis (Figure 6.6.6B and C), it appears that groundwater samples cannot be collected, when the groundwater is generally more than 2 meters below ground. Not until February 2021 after the first cyazofamid application in June 2020, was it possible to take

the first groundwater sample from H1, and here the maximum DMS concentration of 0.32 µg/L is measured (Figure 6.6.6C). This corresponds to DMS being detected 8 months after application in well H1, while DMS is generally detected after one year in the other groundwater wells (see e.g., Figure 6.6.3C). From February to December 2021, corresponding to 10 months, there are constant detections above the limit value in all groundwater samples from well H1. Overall, a decreasing content of DMS is detected after February 2021, and from January to June 2022 the measured concentrations were below the limit value.

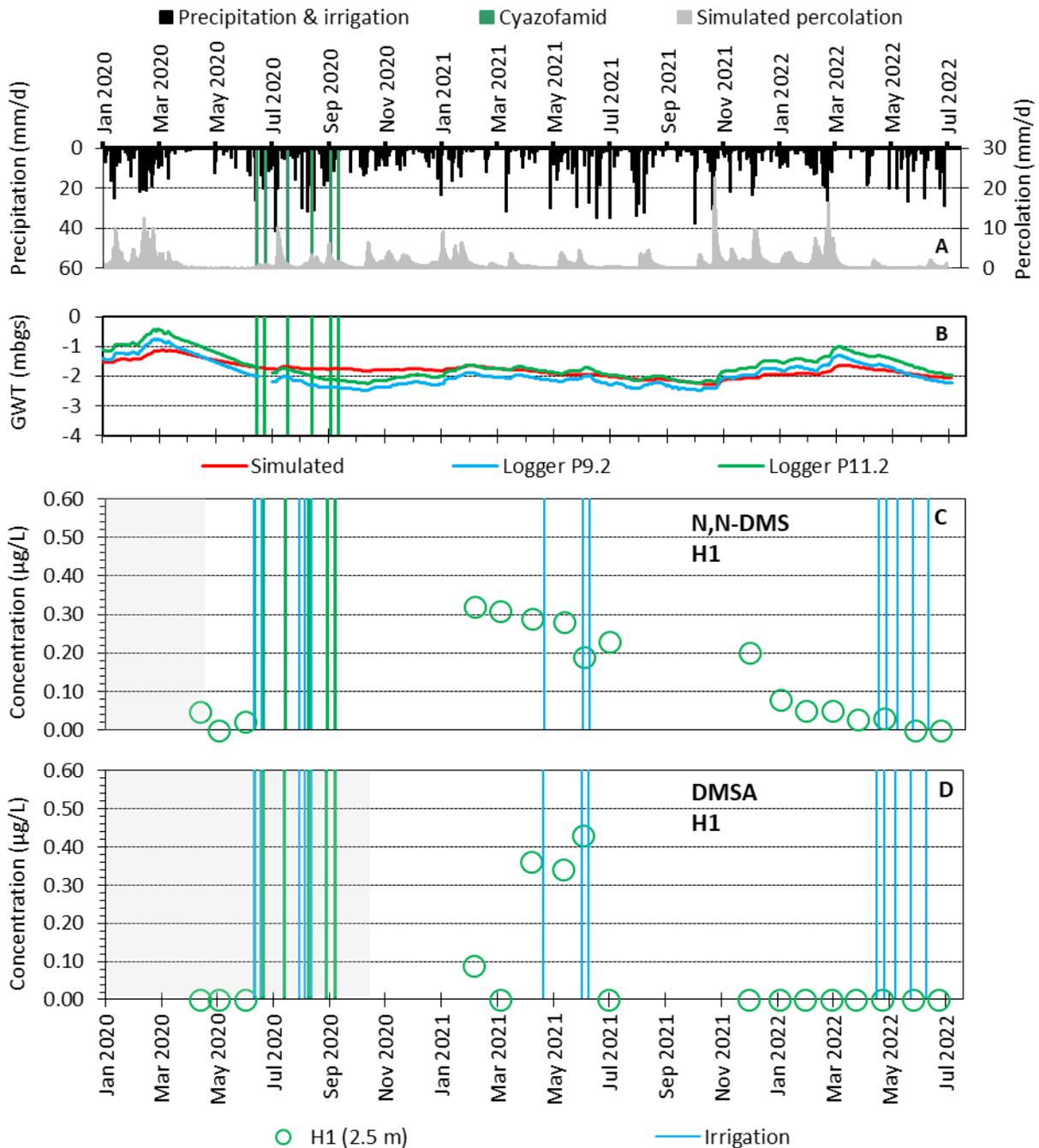


Figure 6.6.6. DMS and DMSA monitoring in horizontal well H1 at Jyndeved. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); measured DMS (C) and DMSA (D) in horizontal well H1. The secondary y-axis represents the percolation (A). Gray shaded areas delineate periods, where samples were stored at -20 °C before analysis. The vertical green and blue lines represent the cyazofamid applications and field irrigations, respectively. Monitoring of DMS and DMSA is ongoing.

In well H1, DMSA is also only detected in February 2021 at the first possible sampling event after the cyazofamid applications. Subsequently, DMSA is constantly detected in groundwater samples from April to June 2021, where the limit value is exceeded in all samples. The maximum DMSA concentration of 0.43 µg/L is measured in June 2021 (Figure 6.6.6D). Subsequently, there are no more DMSA detections in the groundwater samples from H1.

#### *Well M5*

In well M5, the sampling varies between quarterly and half-yearly. In well M5, neither DMS nor DMSA is detected in any of the collected groundwater samples (Figure 6.6.7C-D). Thus, the observations from well M5 are markedly different compared to observations in wells M1, M2, M4, and H1, all of which had detections of both DMS and DMSA.

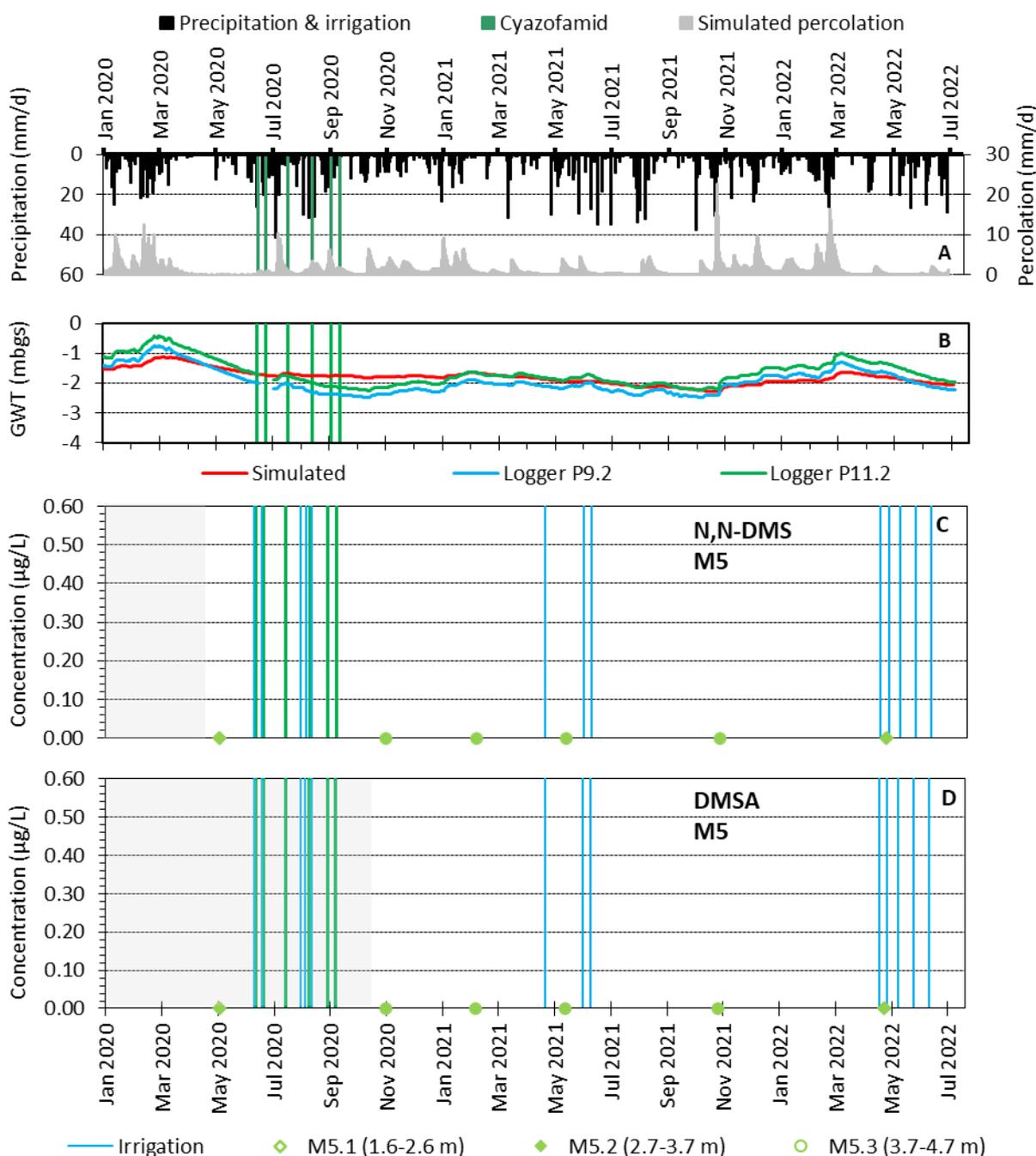


Figure 6.6.7. DMS and DMSA monitoring in well M5 at Jyndevid. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); measured DMS (C) and DMSA (D) in monitoring well M5. The secondary y-axis represents the percolation (A). Gray shaded areas delineate periods, where samples were stored at -20 °C before analysis. The vertical green and blue lines represent the cyazofamid applications and field irrigations, respectively. Monitoring of DMS and DMSA is ongoing.

#### Well M7

Groundwater samples from well M7, which is an upstream well, also show detections of DMS and DMSA with maximum concentrations of 0.21 and 0.47 µg/L, respectively (Figure 6.6.8C and D). From intake M7.2, which represents a depth of approximately 3 meters below ground, groundwater samples were collected continuously throughout the monitoring period. From samples taken in screen M7.2, it appears that DMS and DMSA are detected respectively 21 (in March 2022) and 19 (in January 2022) months after the first

cyazofamid application in June 2020. After the first detections, the DMS concentrations are increasing towards the latest sampling event in June 2022, while the DMSA detections reach their maximum in May 2022. The DMS and DMSA detections in well M7 occurred substantially later than what was observed in the downstream groundwater wells, where DMS and DMSA were detected. In these groundwater wells, DMS and DMSA are detected approximately one year after the first cyazofamid application.

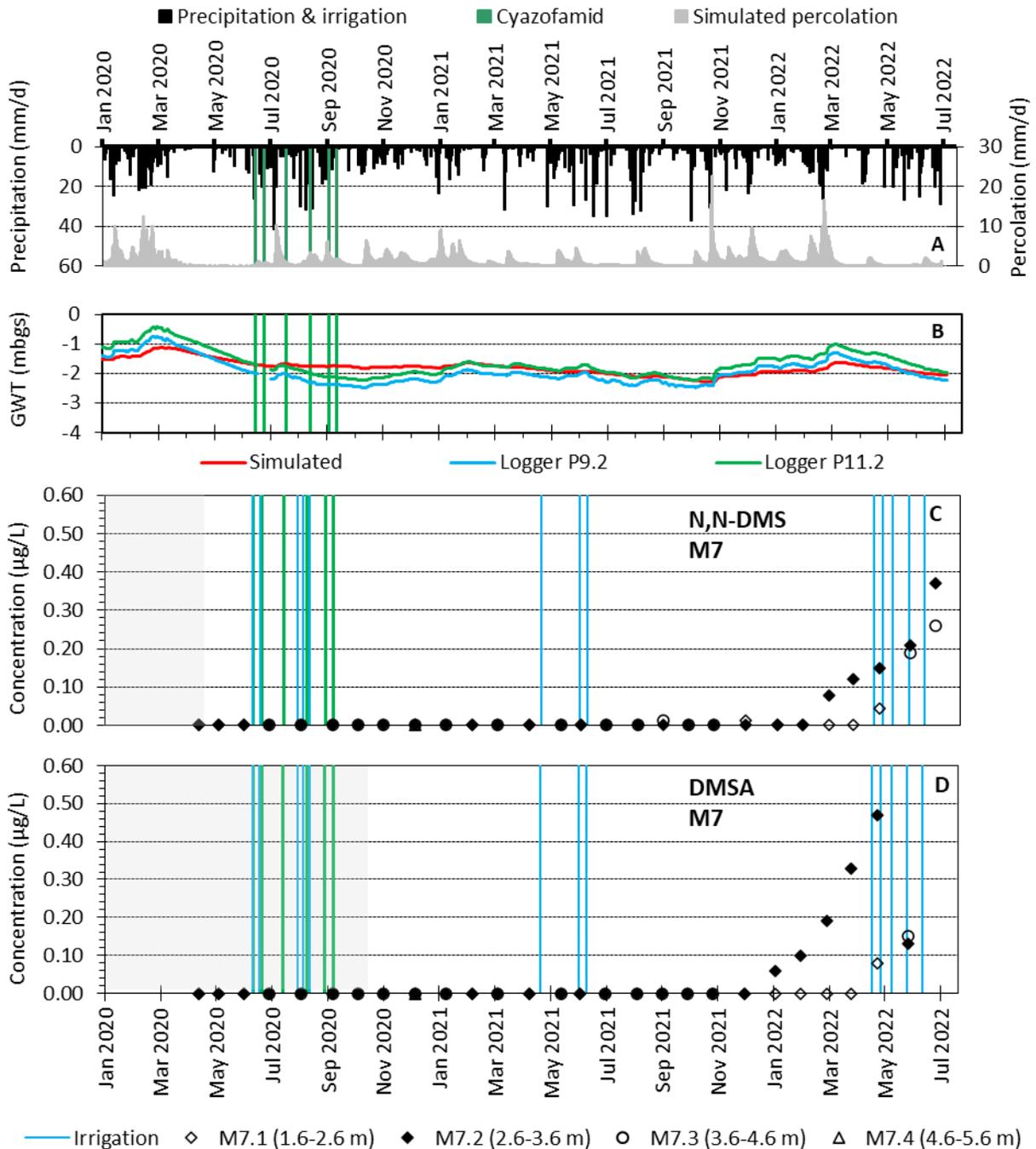


Figure 6.6.8. DMS and DMSA monitoring in well M7 at Jynde vad. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); measured DMS (C) and DMSA (D) in monitoring well M7. It is noted that M7 is an upstream monitoring well. The secondary y-axis represents the percolation (A). Gray shaded areas delineate periods, where samples were stored at -20 °C before analysis. The vertical green and blue lines represent the cyazofamid applications and field irrigations, respectively. Monitoring of DMS and DMSA is ongoing.

### Irrigation water

The irrigation water used at the Jynde vad field is obtained from four wells east and northeast of the field. The nearest well is located 2-300 m east (i.e., upstream of the field), and screened from 15.5 to 21.5 mbgs. The remaining irrigation wells are located at distances of 500-1000 m from the field (Table 6.6.3, Figure 6.6.9). Commonly, it is not possible to determine which wells supply the irrigation water as all pumps in the four wells are connected in series. However, the water sample from May 19, 2022, was specifically taken from the nearest irrigation well (Figure 6.6.9, DGU no. 167.1089).

Table 6.6.3. Irrigation wells in proximity of the Jynde vad field. Irrigation water is commonly mixed from all four wells.

DGU well no.	Depth (m)	Intake depth (mbgs)	Geology	Location relative to PLAP field
167.513	7.5	na.	na.	1000 m NNE
167.973	20	10-20	Meltwater sand	800 m NNE
167.892	7.5	na.	na.	500 m NE
167.1089	22	15.5-21.5	Meltwater sand	2-300 m E

The irrigation water used in the field is sampled on six occasions in 2020, 2021, and 2022 (Table 6.6.4). DMS is detected in 5 out of 6 samples, DMSA in 1 out of 6 samples, while CCIM and CTCA were not detected. The DMS concentration was between 0.011 µg/L and 0.027 µg/L, while the DMSA concentration was 0.02 µg/L (note that the DMSA detection limit is 0.02 µg/L).

The analysis of the irrigation water indicates that there were low concentrations of DMS, and perhaps to a lesser extent DMSA, in the groundwater in the area around the Jynde vad field during the monitoring period.

Table 6.6.4. Results from the irrigation water analyses at Jynde vad in 2020-2022. For locations of the irrigation wells, see Figure 6.6.9. Note the different detection limits for DMS and DMSA. DMS DL = 0.01 µg/L and DMSA DL = 0.02 µg/L.

Date	DMS, concentration (µg/L)	DMSA, concentration (µg/L)
07-06-2020	0.011	< 0.02
03-08-2020	0.011	< 0.02
27-04-2021	< 0.01	< 0.02
16-06-2021	0.027	< 0.02
28-04-2022	0.021	0.02
19-05-2022*	0.014*	< 0.02*

\*Water sample from DGU well 167.1089 closest to the field.



Figure 6.6.9. The location of the PLAP field, Jyndevad delineated by the green box. The yellow stars represent the irrigation wells, and the blue arrow shows the general groundwater flow direction.

#### 6.5.4 Discussion on the CTCA, CCIM, DMS, and DMSA monitoring

CTCA and CCIM were not detected in the monitoring, indicating that these metabolites from cyazofamid are not prone to leaching.

In all groundwater wells with DMS detections, there are correspondingly consistent detections of DMSA and vice versa (Figure 6.6.2-8). Both DMS and DMSA are detected in concentrations exceeding the limit value of 0.1 µg/L. Also, the detected concentrations are relatively high, in some cases up to a factor of 5 higher than the limit value. In all groundwater wells with DMS- and DMSA detections, there are generally consistent patterns of DMSA concentrations above the limit value being detected earlier than DMS is detected in concentrations > 0.1 µg/L. For instance, DMSA is detected above the limit value approximately three months before DMS is detected in concentrations > 0.1 µg/L in well M1 (Figure 6.6.3) and approximately five months before DMS is detected above the limit value in well M4 (Figure 6.6.5). The period in which measured DMS- and DMSA concentrations exceed 0.1 µg/L varies between the different wells. However, there is a tendency for a longer period with continued leaching of DMS than there is for DMSA e.g., in well M1, DMS is detected in concentrations > 0.1 µg/L during approximately one year (Figure 6.6.6C) while DMSA is detected in concentrations > 0.1 µg/L for approximately half a year (figure 6.6.6D). At the most recent sampling in June 2022, the measured DMS and DMSA concentrations were < 0.1 µg/L in well M1. In well M4, where DMS is

also measured in concentrations  $> 0.1 \mu\text{g/L}$  during approximately one year, the latest sampling in June 2022 still yields DMS detections above  $> 0.1 \mu\text{g/L}$  (Figure 6.6.5C). In well M4, measured DMSA concentrations are not similarly constant, but DMSA is measured in the majority of samples in concentrations  $> 0.1 \mu\text{g/L}$  over the past year (Figure 6.6.5D).

The monitoring from well M2 shows that the DMS- and DMSA detections are not comparable to wells M1 and M4 concerning both the number of detections  $> 0.1 \mu\text{g/L}$  and the concentration magnitude. Thus, in well M2, there was only one detection of DMS and DMSA  $> 0.1 \mu\text{g/L}$  (Figure 6.6.4), while wells M1 and M4 showed overall constant detections  $> 0.1 \mu\text{g/L}$  during approximately 0.5-1 year. Further, the measured maximum concentration level of DMS in well M2 is  $0.15 \mu\text{g/L}$ , which is substantially lower compared to the maximum concentration in well M1 and M4 equivalent to  $0.44$  and  $0.29 \mu\text{g/L}$ , respectively. An explanation of the difference in detections in well M2 compared to wells M1 and M4 may be that the sampling frequency is reduced in well M2. Sampling in well M2 is quarterly, which is why the number of samples for analysis is lower compared to wells M1 and M4, where sampling is monthly. Thus, it is possible that well M2 was not sampled during periods where high DMS- and DMSA concentrations could potentially be present.

In the horizontal groundwater well H1 located below the field, DMS was detected earlier in concentrations  $> 0.1 \mu\text{g/L}$  compared to the other groundwater wells. In well H1, DMS is detected approximately 8 months after the first cyazofamid application (Figure 6.6.6C), while DMS detections  $> 0.1 \mu\text{g/L}$  are generally observed approximately after one year in the other groundwater wells (e.g. Figure 6.6.3C). The reason DMS is observed earlier in well H1 is likely that H1 is located directly below the field, meaning that the transport time is relatively short compared to wells M1, M2, and M4, which are located in the buffer zone approximately 15-20 meters downstream of the cultivated area of the field (Figure 2.1.1, Chapter 2). Therefore, DMS could be present in the groundwater below the field before the observed findings. This cannot be verified, as the groundwater table was deeper than the intake depth of well H1 in the period up to the first discovery. However, previous tracer experiments with bromide show that maximum bromide concentrations in well H1 were found approximately 5 months after tracer application, while it took approximately 14 months in the remaining downstream wells (Badawi *et al.*, 2022).

In well M5, DMS- and DMSA are not detected (Figure 6.6.7). This is because the well does not represent the water flowing from the field to the groundwater to the same degree as the wells M1, M2, M4, and H1. As mentioned above, it is therefore not assumed that M5 represents the flow field from the field to the same extent. This is supported by previous bromide tracer experiments, where the detections differ substantially from the other downstream wells (Badawi *et al.*, 2022).

In the upstream well M7, both DMS and DMSA are detected. It appears that a pulse of DMSA is detected earlier than of DMS, which is also observed in the other groundwater wells with detections. In principle, no DMS or DMSA should be detected in well M7, as it is considered an upstream well. This means that the well represents water and groundwater flowing towards the field and, thus, not affected by water from the field itself. To explain the DMS and DMSA detections, it was investigated which crops were grown on the adjacent fields and which pesticide products were reported to the Danish Environmental Protection Agency's IT system SJI. It is mandatory to report which pesticide products are applied for a given crop to SJI. On the field immediately east of the VAP field, located upstream (Figure 6.6.9), potatoes were grown in 2021, and permission for a cyazofamid product was given. If the cyazofamid application was conducted in this neighboring field around the summer of 2021, it corroborates with the DMS- and DMSA detections in early 2022, as the transport time for DMS and DMSA to well M7 is expected to be shorter than what is observed for the downstream wells on the Jynde vad field (approximately one year). This is because the distance from well M7 to the neighboring field is shorter than the distance from the cultivated area in the Jynde vad field to

the downstream wells (Figure 2.1.1 and Figure 6.6.9). Therefore, it is likely that the DMS- and DMSA detections in the upstream well stem from a cyazofamid application on the neighboring field in 2021.

It is noted that DMS is present in some of the groundwater wells before the first cyazofamid application in June 2020. Before this application, DMS is detected in well M4 with concentrations of 0.021 µg/L in a single background sample (Figure 6.6.5C), and twice in H2 in concentrations of 0.023 and 0.048 µg/L (Figure 6.6.6C). The DMS detections in background samples from H1 are likely because cyazofamid is previously used in the field, most recently in 2014. This was also found in the research project TRIAFUNG developing the analytical method for DMS and 1,2,4-triazole used for research purposes in the GEUS laboratory. Here, in September 2019, they detected relatively low DMS concentrations (< 0.04 µg/L) in water from the Jyndevad field. Further, DMS is detected in all but one of the irrigation samples, suggesting that DMS is present in the groundwater in low concentrations in the area (Table 6.6.4).

The DMS- and DMSA detections in the suction cups representing the variably saturated soil below the field support that the DMS- and DMSA findings in the groundwater wells come from the field. The DMS and DMSA detections in the suction cups occurred 2-3 months after the first cyazofamid application (Figure 6.6.2), and the overall leaching pattern is comparable to what is generally observed in the monitoring wells downstream of the field. Thus, there is an earlier breakthrough of relatively high concentrations of DMSA compared to DMS. Further, the DMS pulse is also of longer duration than DMSA in the variably saturated zone, which is also the overall trend in the groundwater wells.

#### 6.5.5 Conclusion on the cyazofamid test at Jyndevad

After cyazofamid application on the Jyndevad field, the monitoring shows that the degradation products CCIM and CTCA are not detected in any of the samples collected. In contrast, DMS and DMSA are generally detected in concentrations > 0.1 µg/L and over long periods (approximately 6-12 months) in groundwater wells. During these periods, the DMS- and DMSA concentrations exceeded the limit value by a factor of 2-4, while individual measurements exceeded the limit value by up to a factor of 8. Further, there is a consistent pattern of DMSA being detected earlier in groundwater below the field than DMS, and the first breakthroughs of the two degradation products in concentrations > 0.1 µg/L generally occurred approximately one year after the first cyazofamid application. The results show that the duration (pulse) of detections is longer for DMS than for DMSA, although the maximum detected concentrations of DMSA are higher than for DMS. The detections from water samples in the suction cells at 1 mbgs, representing flow from the field down to the groundwater, support the results from the groundwater wells. Thus, analyses from 1 mbgs show that DMS and DMSA leach in concentrations > 0.1 µg/L, that DMS and DMSA are found 2-3 months after the first cyazofamid application, and that the duration of DMSA detections is shorter than for DMS.

DMS- and DMSA detections in upstream well M7 are not considered to originate from the cyazofamid application on the VAP field. This is because (i) the groundwater flow direction from the field is west and well M7 is located east of the field, (ii) the time of the detections is later than what was observed in the other groundwater wells downstream of the field, and (iii) that the neighboring field was cultivated with potatoes in 2021, and cyazofamid was most likely used in the potato crop. Thus, the detections observed later in well M7 are likely related to the cyazofamid application on the neighboring field, where potatoes are grown a year later than on the Jyndevad field.

From the analysis of the spray solution, it is clear that cyazofamid is hydrolyzed to CCIM and DMSA before the solution is sprayed on the field. The contribution of DMSA from the spray solution to the field is not considered to be the primary source of leaching of DMSA, as the content of DMSA in the solution only contributed with approximately 3% of the added cyazofamid. This result is supported by a column experiment

(Badawi *et al.* 2023), where the leaching of DMSA from the columns is more than 6 times higher than that supplied to the columns via the aqueous cyazofamid spike solution.

In the study by Badawi *et al.* (2023), both batch degradation and soil column experiments support the results from the monitoring at the PLAP field at Jyndevad. Cyazofamid has been shown to break down relatively quickly in soil. Degradation of cyazofamid produces both DMS and DMSA, whereas the formation of DMSA from DMS degradation is not observed. Furthermore, the column leaching experiment shows that DMS and DMSA leach in concentrations above the limit value after addition of cyazofamid in a concentration corresponding to one field application (80 g cyazofamid/L per hectare). Leaching of CCIM or CTCA (CTCA detected once in one column leachate) was not detected in the column experiment, which is consistent with the PLAP results.

## 6.6 Cycloxydim test

Two degradation products, BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO from the herbicide cycloxydim, are monitored in the current monitoring period, July 2020-June 2022, following cycloxydim applications on the clay till field Silstrup. Detailed information on the field sites included in the test is available in Chapter 2.

### 6.6.1 Application of cycloxydim at Silstrup

Cycloxydim was tested in PLAP in connection with cropping of winter rapeseed and was applied at Silstrup on September 17, 2018. Detailed information on agricultural management is available in Chapter 3, Appendices 3 and 7.

Cycloxydim was previously applied in sugar beets at Faardrup in 2009 (not monitored), and in peas at Jyndevad in 2017. The results from the cycloxydim application in 2017 are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk).

### 6.6.2 Compounds included in the monitoring

Two degradation products, BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO, from cycloxydim, were selected for monitoring at Silstrup. The monitoring started in August 2018 and ended in October 2020.

### 6.6.3 Results of the BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO monitoring

Cycloxydim was applied on September 17, 2018. In total, 10 samples were collected in drainage and monitoring wells before the cycloxydim application and none of these contained any of the two degradation products, E/Z BH 517-TSO and BH 517-T2SO<sub>2</sub> (Figure 6.7.1).

An overview of the entire monitoring at Silstrup is given in Table 6.7.1 and shows the number of detections in drainage and monitoring wells from the cycloxydim application in September 2018, to the end of October 2020. It is noted that since the publication of the previous PLAP report, a data gap between January and March 2019 was discovered. Hence, the sample counts and Figure 6.7.1 is updated for E/Z BH 517-TSO and BH 517-T2SO<sub>2</sub> in the current report.

Table 6.7.1. Number of samples and detections of BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO at Silstrup in drainage (D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from September 17, 2018, to October 28, 2020, when the monitoring ended. Background samples collected before application of cycloxydim are not included in the counting.

	Total			D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	N	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Silstrup</b>															
<b>BH 517-T2SO<sub>2</sub></b>	195	0	0	49	0	0	103	0	0	43	0	0	146	0	0
<b>E/Z BH 517-TSO</b>	195	52	1	49	15	1	103	22	0	43	15	0	146	37	0

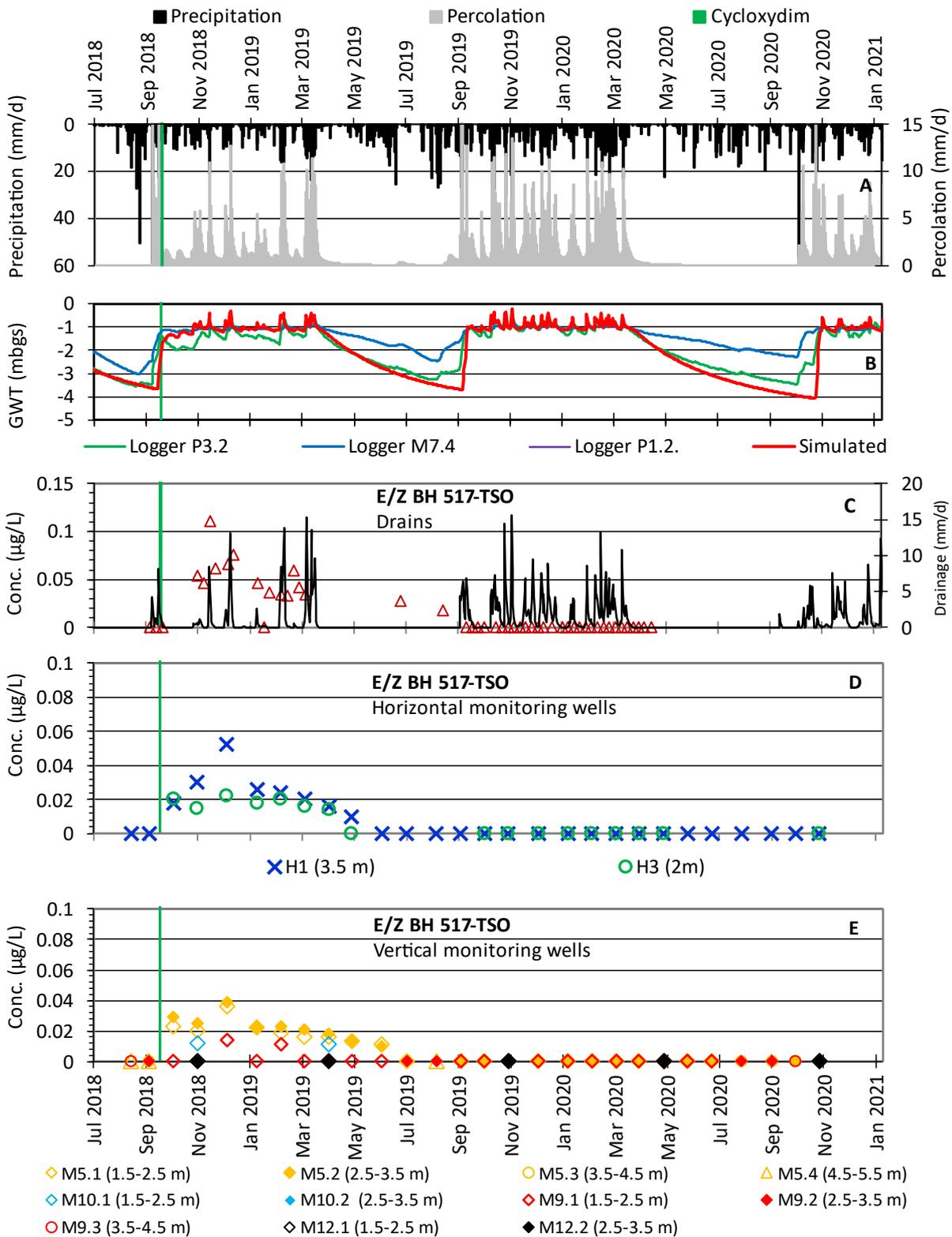


Figure 6.7.1. E/Z BH 517-TSO monitoring at Silstrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); E/Z BH 517-TSO concentration in the variably saturated zone (C), the secondary y-axis represents the drainage flow), and groundwater (D-E). It is noted that M12 is regarded as an upstream monitoring well. The green vertical lines indicate the date of the cycloxydim application. E/Z BH 517-TSO was included in the monitoring in August 2018 and monitoring ended in October 2020.

#### *Variably saturated zone monitoring*

Following the cycloxydim application in September 2018, E/Z BH 517-TSO was detected in drainage samples during the first drainage event in October-November, where the maximum concentration was  $> 0.1 \mu\text{g/L}$  ( $0.11 \mu\text{g/L}$ ) and was observed in November, approximately one month after the cycloxydim application (Figure 6.7.1C). Most of the E/Z BH 517-TSO detections were in October 2018-March 2019 and ranged from  $0.033$  to  $0.11 \mu\text{g/L}$ . In June and August 2019, E/Z BH 517-TSO was detected in two drainage samples in concentrations of  $0.027$  and  $0.017 \mu\text{g/L}$ , respectively (Figure 6.7.1C). E/Z BH 517-TSO is not detected in drainage from September 2019 to the end of the monitoring in October 2020. E/Z BH 517-TSO was detected in 15 out of 49 drainage samples. BH 517-T2SO<sub>2</sub> was not detected in any of the 49 drainage samples.

#### *Groundwater monitoring wells*

E/Z BH 517-TSO was detected in groundwater in concentrations  $< 0.1 \mu\text{g/L}$  ( $0.012$ - $0.029 \mu\text{g/L}$ ) both in the horizontal wells (H1 and H3, Figure 6.7.1D) and downstream monitoring well M5 (Figure 6.7.1E) in October 2018, approximately two weeks after the cycloxydim application. The concentration of E/Z BH 517-TSO in the groundwater increased until December 2018, when the maximum concentration ( $0.052 \mu\text{g/L}$ ) was detected in water from the horizontal well H1 (Figure 6.7.1D). Subsequently, the concentration decreased and there were no detections of E/Z BH 517-TSO in the groundwater after June 2019, where the maximum observed concentration was  $0.011 \mu\text{g/L}$ . E/Z BH 517-TSO was not detected in groundwater samples from the upstream well M12 during the monitoring period. In total, 37 of 146 groundwater samples contained E/Z BH 517-TSO, with no concentrations exceeding the limit value. BH 517-T2SO<sub>2</sub> was not detected in any of the 146 groundwater samples.

#### 6.6.4 Discussion and conclusion of the BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO monitoring

Cycloxydim was tested in winter rapeseed at Silstrup in September 2018 and two of its degradation products, BH 517-T2SO<sub>2</sub> and E/Z BH 517-TSO, were included in the monitoring. None of the degradation products are detected in water from drainage or groundwater in the background samples before the cycloxydim application. The first weeks after the cycloxydim application, the groundwater table was below drain depth, why drainage sampling was not possible, but E/Z BH 517-TSO was detected in drainage when the drainage started approximately one month after the application. In groundwater, E/Z BH 517-TSO was detected 14 days after the cycloxydim application. E/Z BH 517-TSO was once detected in a concentration  $> 0.1 \mu\text{g/L}$  in a drainage sample from November 2018. Compared to the maximum drainage concentration, the concentration of E/Z BH 517-TSO peaked in groundwater one month later in December 2018 ( $0.058 \mu\text{g/L}$ , H1). E/Z BH 517-TSO was last detected in drainage in August 2019 and groundwater in June 2019, while the monitoring continued to October 2020. The relatively fast detections of E/Z BH 517-TSO (with concentrations generally  $< 0.1 \mu\text{g/L}$ ), in both drainage and groundwater, after cycloxydim application, suggests that E/Z BH 517-TSO is further transformed relatively fast to such an extent that the limit value is not exceeded. This is also supported by the consistent sampling of non-detects approximately a year after the cycloxydim application (Figure 6.7.1). In total, 52 of 195 samples contained E/Z BH 517-TSO, with no concentration exceedance of the limit value in groundwater samples. BH 517-T2SO<sub>2</sub> was detected neither in drainage nor groundwater. A total of 49 and 146 samples were collected in drainage and groundwater, respectively from September 2018 to October 2020, when the monitoring ended.

## 6.7 Halauxifen-methyl test

From the herbicide halauxifen-methyl, one degradation product, X-729, is monitored in the current reported monitoring period, July 2020-June 2022, following a halauxifen-methyl application on the clay till fields Estrup and Lund. Detailed information on the field site is available in Chapter 2.

### 6.7.1 Application of Halauxifen-methyl at Estrup and Lund

Halauxifen-methyl was tested in PLAP in connection with cropping of winter barley, spring barley, and winter rapeseed in 2019. Halauxifen-methyl was applied at Estrup in spring barley in May 2019, and in winter barley and winter rapeseed in May and December 2019, respectively at Lund. Detailed information on agricultural management is available in Chapter 3, appendixes 3 and 7, and previous PLAP reports.

Halauxifen-methyl was additionally applied at Silstrup, Faardrup, and Lund in 2018. Monitoring at Silstrup and Faardrup included the degradation product X-757 and ended in September and December 2019, respectively. No monitoring was initiated in connection with the halauxifen-methyl application at Lund in 2018. Results from these halauxifen-methyl tests are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk).

### 6.7.2 Compounds included in the monitoring

One degradation product, X-729, from halauxifen-methyl was selected for monitoring starting in April 2019 at Estrup and Lund and ending in March 2021 at both fields. No analytical method for analysis of X-729 was available at the start of monitoring. Consequently, the water samples collected from April to September 2019 were stored at -20°C (refer to Chapter 7) after which the analytical method was ready. The effect of storing the samples is currently unknown but relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). In the following, it is clearly stated which samples were stored, and overall, 17 of 170 samples at Estrup, and 29 of 149 samples at Lund were stored before analysis.

### 6.7.3 Results of the X-729 monitoring

X-729 was introduced in the monitoring in April 2019 and the halauxifen-methyl application was on May 19, 2019, at Estrup, and the first of two applications at Lund on May 11, 2019. In total, 14 background samples were collected in drainage and monitoring wells, before the halauxifen-methyl applications at each field. X-729 was not detected in any of the samples. An overview of the entire monitoring is given in Table 6.8.1 and shows the number of detections in water from drainage, and monitoring wells from May 2019 to March 2021.

Table 6.8.1. Number of samples (n) and detections of X-729 at Estrup and Lund in drainage (D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from May 11, 2019 at Lund and May 19, 2019 at Estrup to March 2021. Background samples collected before the application of halauxifen-methyl are not included in the counting.

	Total			D			M			H*			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Estrup</b>															
X-729	156	0	0	60	0	0	60	0	0	36	0	0	96	0	0
<b>Lund</b>															
X-729	135	0	0	24	0	0	111	0	0	-*	-*	-*	111	0	0

\*No horizontal monitoring well is installed at Lund.

#### *Variably saturated zone and groundwater monitoring wells*

A total of 60 and 96 samples were collected from drainage and groundwater monitoring wells, respectively at Estrup, and 24 and 111 samples from drainage and groundwater monitoring wells, respectively at Lund in connection with the halauxifen-methyl tests from May 2019 to March 2021. X-729 was not detected in any of the collected samples at Estrup and Lund neither in water from the variably saturated zone (drainage) nor in groundwater.

#### 6.7.4 Discussion and conclusion of the X-729 monitoring

Halauxifen-methyl was tested in 2019 in spring barley at Estrup, and winter barley and winter rapeseed at Lund. The degradation product, X-729 was included in the monitoring and was not detected in drainage or groundwater, neither in the period before the halauxifen-methyl applications (May 2019) nor in the monitoring period after application from June 2019 to March 2021, where the monitoring ended at both Estrup and Lund. In conclusion, X-729 does not give rise to groundwater detections above the limit value during the monitoring period.

It should be noted that the bromide tracer test done at Lund in 2017, seemed to have been erroneous. Consequently, the hydraulic connectivity of the screens and the groundwater is yet unclear. This might affect the interpretation of the test, as the lack of X-729 detections can be a consequence of lacking hydraulic connectivity (refer to Chapter 5.5). However, as X-729 is not detected in drainage during the monitoring period, the compound is not expected to leach into the groundwater.

## 6.8 Florasulam test

Four degradation products, TSA, 5OH-florasulam, DFP-ASTCA, and DFP-TSA from florasulam, are monitored in the current monitoring period, July 2020-June 2022, following florasulam applications on the three clay till fields Silstrup, Estrup, and Lund. Detailed information on the field sites included in the test is available in Chapter 2.

### 6.8.1 Application of florasulam at Silstrup, Estrup, and Lund

Florasulam was tested in PLAP in connection with cropping of winter wheat and winter barley during 2020-2022. Florasulam was applied in winter wheat on April 7, 2020 at Silstrup and on May 3, 2020 at Estrup, and in winter barley on May 11, 2019 at Lund. Detailed information on agricultural management is available in Chapter 3, Appendix 3 and 7, and previous PLAP reports.

Florasulam was previously applied at Jyndevad in 2006 and 2012, at Tylstrup in 2012 and 2015, at Silstrup in 2017, at Estrup in 2006, 2012 and 2014, at Faardrup 2015 and 2017, and at Lund in 2018. The results from the florasulam applications from 2006-2018 are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk)

### 6.8.2 Compounds included in the monitoring

Initially, five degradation products from florasulam, ASTCA, DFP-ASTCA, DFP-TSA, TSA, and 5OH-florasulam were selected for monitoring starting in April 2020 at Silstrup and Estrup. During the analytical method development, ASTCA showed instability in aqueous solution and an analytical method could not be developed. ASTCA was therefore omitted from the monitoring programme. Monitoring of the four degradation products, TSA, DFP-ASTCA, DFP-TSA, and 5OH-florasulam was done from April 2020 to March 2022 at both the Silstrup and Estrup fields.

In connection with the florasulam test at Lund, only monitoring of TSA was initiated in May 2018 and continued until March 2021.

Monitoring of the four degradation products was planned to start in April 2020, but analytical methods for analyses of 5OH-florasulam, DFP-ASTCA, and DFP-TSA were not available at that time. Consequently, the water samples collected from April to October 2020 were stored at -20°C (refer to Chapter 7) after which the analytical methods were ready and samples were analysed. The effect of storing the samples is currently unknown but relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). In the following, it is clearly stated which samples were stored, and overall, 30 and 33 of 186 and 193 samples were stored before analysis at Estrup and Silstrup, respectively.

### 6.8.3 Results of the DFP-ASTCA, DFP-TSA, TSA, and 5-OH-florasulam monitoring

Four days before the first florasulam application at Estrup, background samples were collected in the horizontal well (H1) and the monitoring wells (M1, M4, M5, M6). Nine samples were collected and none of these contained any of the four degradation products. At Silstrup, one background sample was collected in drainage the day before application and none of the four degradation products were detected. At Lund, where only TSA was included in the monitoring, TSA was monitored continuously from May 2018 and was detected neither in drainage nor groundwater before the application in May 2019.

An overview of the entire monitoring is given in Table 6.9.1 and shows the number of detections in drainage and monitoring wells during the monitoring period from April/May 2020 to March 2022 at Silstrup and Estrup, and from May 2019 to March 2021 at Lund.

Table 6.9.1. Number of samples and detections of 5OH-florasulam, DFP-ASTCA, DFP-TSA, and TSA at Silstrup, Estrup and Lund in drainage (D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected after the florasulam applications from April 7, 2020 at Silstrup, May 3, 2020 at Estrup, and May 11, 2019 at Lund to July 2022. Background samples collected before applications of florasulam are not included in the counting. It is noted that one analysis result of TSA in a drainage sample is missing at Silstrup, and one extra sample was analysed for TSA at Estrup.

	Total			D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Silstrup</b>															
5OH-florasulam	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
DFP-ASTCA	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
DFP-TSA	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
TSA	191	1	0	49	1	0	100	0	0	42	0	0	142	0	0
<b>Estrup</b>															
5OH-florasulam	177	8	1	68	8	1	68	0	0	41	0	0	109	0	0
DFP-ASTCA	177	0	0	68	0	0	68	0	0	41	0	0	109	0	0
DFP-TSA	177	0	0	68	0	0	68	0	0	41	0	0	109	0	0
TSA	178	0	0	69	0	0	68	0	0	41	0	0	109	0	0
<b>Lund</b>															
TSA	135	0	0	24	0	0	111	0	0	-*	-*	-*	111	0	0

\*No horizontal monitoring well is installed at Lund.

#### Variably saturated zone monitoring

DFP-ASTCA and DFP-TSA were not detected in drainage, but the two degradation products, 5-OH-florasulam and TSA are detected during the monitoring from April/May 2020 to June 2022.

5-OH-florasulam was detected in eight drainage samples from Estrup (Figure 6.9.1C, Table 6.9.1), with one detection > 0.1 µg/L. This detection corresponded to the maximum concentration of 5-OH-florasulam (0.35 µg/L) and was detected in July 2020, approximately two months after the florasulam application in May 2020. Thereafter, 5-OH-florasulam was detected in decreasing concentrations (< 0.1 µg/L) until February 2021, when the compound was last detected in a concentration of 0.011 µg/L. 5-OH-florasulam was not detected in drainage from Silstrup and was not included in the monitoring at Lund.

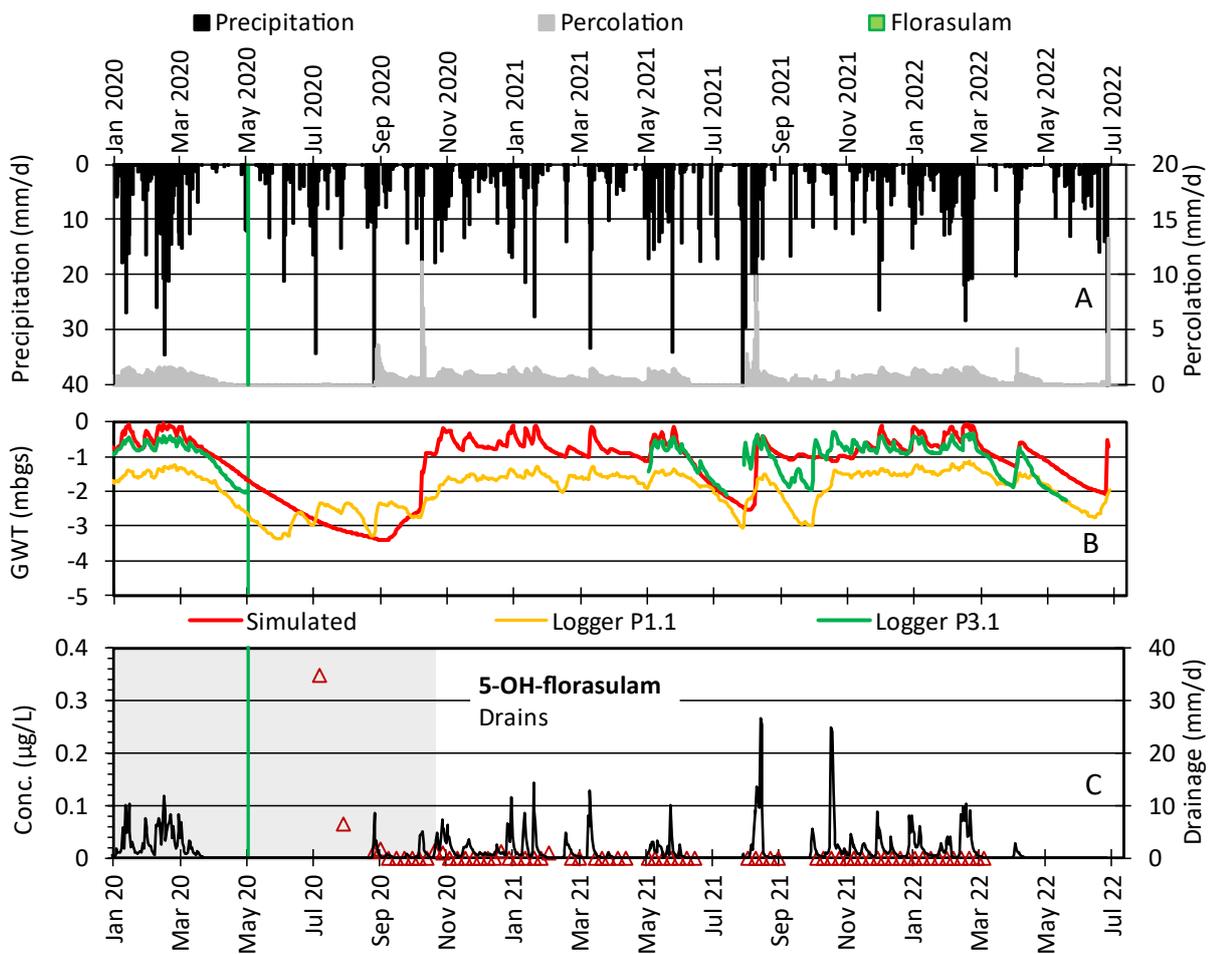


Figure 6.9.1. 5-OH-florasulam monitoring at Estrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); 5-OH-florasulam measured in the variably saturated zone (C); The secondary y-axis (plot C) represents the drainage flow. The vertical green lines indicate the date of the florasulam application. The gray shaded areas delineate periods, where samples were stored at -20°C before analysis. Note that the evaluated results cover April 2020 to March 2022.

TSA was only detected once during the monitoring period. This was in a drainage sample from Silstrup in February 2021 (0.061 µg/L), almost one year after the application of florasulam in April 2020.

A total of 50, 68, and 24 drainage samples were collected from Silstrup, Estrup and Lund, respectively (Table 6.9.1).

#### Groundwater monitoring wells

The four florasulam degradation products, 5OH-florasulam, DFP-ASTCA, DFP-TSA, and TSA were neither detected in groundwater at Silstrup nor Estrup, and TSA was not detected in groundwater at the Lund field.

The monitoring of 5OH-florasulam, DFP-ASTCA, DFP-TSA, and TSA was stopped in March 2022 at Silstrup and Estrup, and the monitoring of TSA was stopped at Lund in March 2021. A total of 142, 109, and 111 groundwater samples were collected from Silstrup, Estrup, and Lund, respectively, during the monitoring period (Table 6.9.1).

#### 6.8.4 Discussion and conclusion of DFP-ASTCA, DFP-TSA, TSA, and 5-OH-florasulam monitoring

Florasulam was tested in two different crops, winter wheat at Estrup and Silstrup, and winter barley at Lund from July 2020 to June 2022. None of the four included degradation products are detected in groundwater at Silstrup, Estrup, and Lund (at which only TSA was monitored). However, TSA and 5-OH-florasulam were detected in drainage at Silstrup and Estrup, respectively, and only 5-OH-florasulam is detected in a concentration > 0.1 µg/L (Figure 6.9.1). This detection was in a drainage sample from Estrup approximately two months after the florasulam application in May 2020. DFP-ASTCA and DFP-TSA are not detected.

During the monitoring of TSA at Lund from May 2018 to March 2021, there were no detections of TSA (florasulam was also applied in 2018).

Monitoring of the four degradation products, 5OH-florasulam, DFP-ASTCA, DFP-TSA, and TSA at Silstrup and Estrup ended in March 2022 after two years of monitoring.

## 6.9 Fluopyram test

Fluopyram and one degradation product, fluopyram-7-hydroxy are monitored in the current monitoring period, July 2020-June 2022, following fluopyram applications at the sandy field Jyndeved, and the three clay till fields, Silstrup, Faardrup, and Lund. Detailed information on the field sites included in the test is available in Chapter 2.

### 6.9.1 Application of fluopyram at Jyndeved, Silstrup, Faardrup, and Lund

Fluopyram was tested in PLAP with cropping of winter wheat, spring barley, and winter rapeseed during 2020-2022. Fluopyram was applied at Jyndeved in spring barley on May 22, 2022, at Silstrup in spring barley on June 30, 2021 and winter wheat on May 4, and June 10, 2022, at Faardrup in winter rapeseed on May 26, 2021 and winter wheat twice on May 4 and 30, 2022, and at Lund in winter wheat on June 9, 2021 and spring barley on May 31, 2022. Detailed information on agricultural management is available in Chapter 3, Appendixes 3 and 7, and previous PLAP reports.

Fluopyram was not applied in PLAP prior to the tests initiated in 2021.

### 6.9.2 Compounds included in the monitoring

In the 2021 fluopyram test at Silstrup, Faardrup, and Lund, only fluopyram was included in the monitoring, but in the 2022 fluopyram tests at Jyndeved, Silstrup, Faardrup, and Lund, the degradation product, fluopyram-7-hydroxy, was additionally included.

Monitoring of fluopyram was initiated in April 2021 at Silstrup, Faardrup and Lund, and at Jyndeved in February 2022. The degradation product, fluopyram-7-hydroxy was included in the monitoring in February 2022 at all four fields, and the monitoring of fluopyram and fluopyram-7-hydroxy is ongoing.

### 6.9.3 Results of the fluopyram and fluopyram-7-hydroxy monitoring

Before the fluopyram test in May/June 2021 on the clay till fields, results from the background sampling (started in April 2021) showed that fluopyram was not detected in any drainage- or groundwater samples. In total, 28, 15, and 14 samples were collected from Silstrup, Faardrup, and Lund, respectively.

Fluopyram and fluopyram-7-hydroxy were included in the monitoring in February 2022 at Jyndeved and fluopyram was applied on May 22, 2022. In total, 42 samples were collected in suction cups and monitoring wells before the fluopyram application, and none of these contained fluopyram or fluopyram-7-hydroxy. The Jyndeved field was irrigated three times in the period before fluopyram application and two of the three irrigation samples were analysed for fluopyram or fluopyram-7-hydroxy. None of the irrigation water samples contained fluopyram or fluopyram-7-hydroxy.

Fluopyram-7-hydroxy was added to the ongoing monitoring of fluopyram at Silstrup, Faardrup, and Lund in February 2022, when fluopyram for the second consecutive year was applied in May and June at Silstrup, twice in May at Faardrup, and once in May at Lund. Before these applications, a total of 32, 36, and 38 background samples were collected for analysis of fluopyram-7-hydroxy in drainage and groundwater monitoring wells at Silstrup, Faardrup, and Lund, respectively. Fluopyram-7-hydroxy was detected in two of these background samples collected from drainage before the May application in Silstrup. Both detections from February were  $< 0.1 \mu\text{g/L}$ . As fluopyram was applied to the fields for the second year in a row, the detection of fluopyram-7-hydroxy was not unexpected. However, fluopyram-7-hydroxy was not detected in drainage or groundwater before the application in May 2022 at Faardrup and Lund.

An overview of the entire monitoring is given in Table 6.10.1 and shows the number of detections in drainage and monitoring wells during the monitoring period from May 2022 to June 2022 at Jynde vad, and May/June 2021 to June 2022 at Silstrup, Faardrup and Lund.

Table 6.10.1. Number of samples and detections of fluopyram and fluopyram-7-hydroxy at Jynde vad, Silstrup, Faardrup, and Lund in suction cups (Jynde vad only) and drainage (S/D), vertical monitoring wells (M) and horizontal wells (H). The fluopyram counting comprises all samples collected from May 22, 2022 to June 2022 at Jynde vad, and May 26, June 9 and 30, 2021 to June 2022 at Faardrup, Lund, and Silstrup, respectively. The fluopyram-7-hydroxy counting comprises all samples collected from May 4, 2022 at Silstrup and Faardrup to June 2022, and from May 22 and 31, 2022 to June 2022 at Jynde vad and Lund, respectively. Background samples collected before the fluopyram applications and analyses of irrigation water (Jynde vad) are not included in the counting.

	Total			S*/D			M			H <sup>B</sup>			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Jynde vad</b>															
Fluopyram	9	0	0	2	0	0	6	0	0	1	0	0	7	0	0
Fluopyram-7-hydroxy	9	0	0	2	0	0	6	0	0	1	0	0	7	0	0
<b>Silstrup</b>															
Fluopyram	91	21	1	24	17	1	46	4	0	21	0	0	67	4	0
Fluopyram-7-hydroxy <sup>A</sup>	8	0	0	0	0	0	6	0	0	2	0	0	8	0	0
<b>Faardrup</b>															
Fluopyram	81	0	0	27	0	0	41	0	0	13	0	0	54	0	0
Fluopyram-7-hydroxy	18	0	0	8	0	0	8	0	0	2	0	0	10	0	0
<b>Lund</b>															
Fluopyram	88	0	0	22	2	0	66	0	0	- <sup>B</sup>	- <sup>B</sup>	- <sup>B</sup>	66	0	0
Fluopyram-7-hydroxy	6	0	0	0	0	0	6	0	0	- <sup>B</sup>	- <sup>B</sup>	- <sup>B</sup>	6	0	0

<sup>A</sup> data from suction cups at Jynde vad, <sup>A</sup> fluopyram-7-hydroxy included from May 2022 after fluopyram application. <sup>B</sup> No horizontal monitoring well is installed at Lund.

#### Variably saturated zone monitoring

During the monitoring from May/June 2021 to June 2022, a total of 24, 27, and 22 drainage samples were collected from Silstrup, Faardrup, and Lund, respectively. At Jynde vad, 2 samples were collected from suction cups in the period from May to June 2022.

Fluopyram and fluopyram-7-hydroxy are not detected in suction cups at Jynde vad nor drainage at Faardrup during the monitoring from May/June 2021 to June 2022. Note that the monitoring period at Jynde vad runs only from May 22 (fluopyram application date) to June 30, 2022 (approximately three months), hence data should be interpreted as preliminary.

At Silstrup, fluopyram is detected in 17 drainage samples out of 24 (Figure 6.10.1, Table 6.10.1), with one detection in a concentration > 0.1 µg/L. This detection corresponded to the maximum concentration of fluopyram (0.21 µg/L) and was detected on July 28, 2021, approximately one month after the first fluopyram application in June 2021. Thereafter, fluopyram is detected in concentrations < 0.1 µg/L until April 2022, when the drainage stops, and the last measured drainage concentration was 0.025 µg/L. From August 2021 to April 2022 the concentration of fluopyram fluctuates below 0.1 µg/L and peaks twice in October 2021 and February 2022 with maximum concentrations of 0.086 µg/L and 0.054 µg/L, respectively (Figure 6.10.1C). Fluopyram-7-hydroxy is detected twice in drainage (0.014 µg/L and 0.012 µg/L) in February 2022 following the June 2021 fluopyram application. As the drainage stopped in April 2022, no drainage samples were available during May and June 2022, when fluopyram was once again applied at Silstrup.

At Lund, fluopyram is detected in two drainage samples out of 22 (Table 6.10.1) after the application of fluopyram in June 2021, both in concentrations < 0.1 µg/L. Fluopyram was detected once in December 2021 (0.033 µg/L) and the following year in February 2022 (0.017 µg/L). The groundwater table dropped below 2 mbgs in May 2022, hence no drainage samples were available at Lund following the May 2022 fluopyram application.

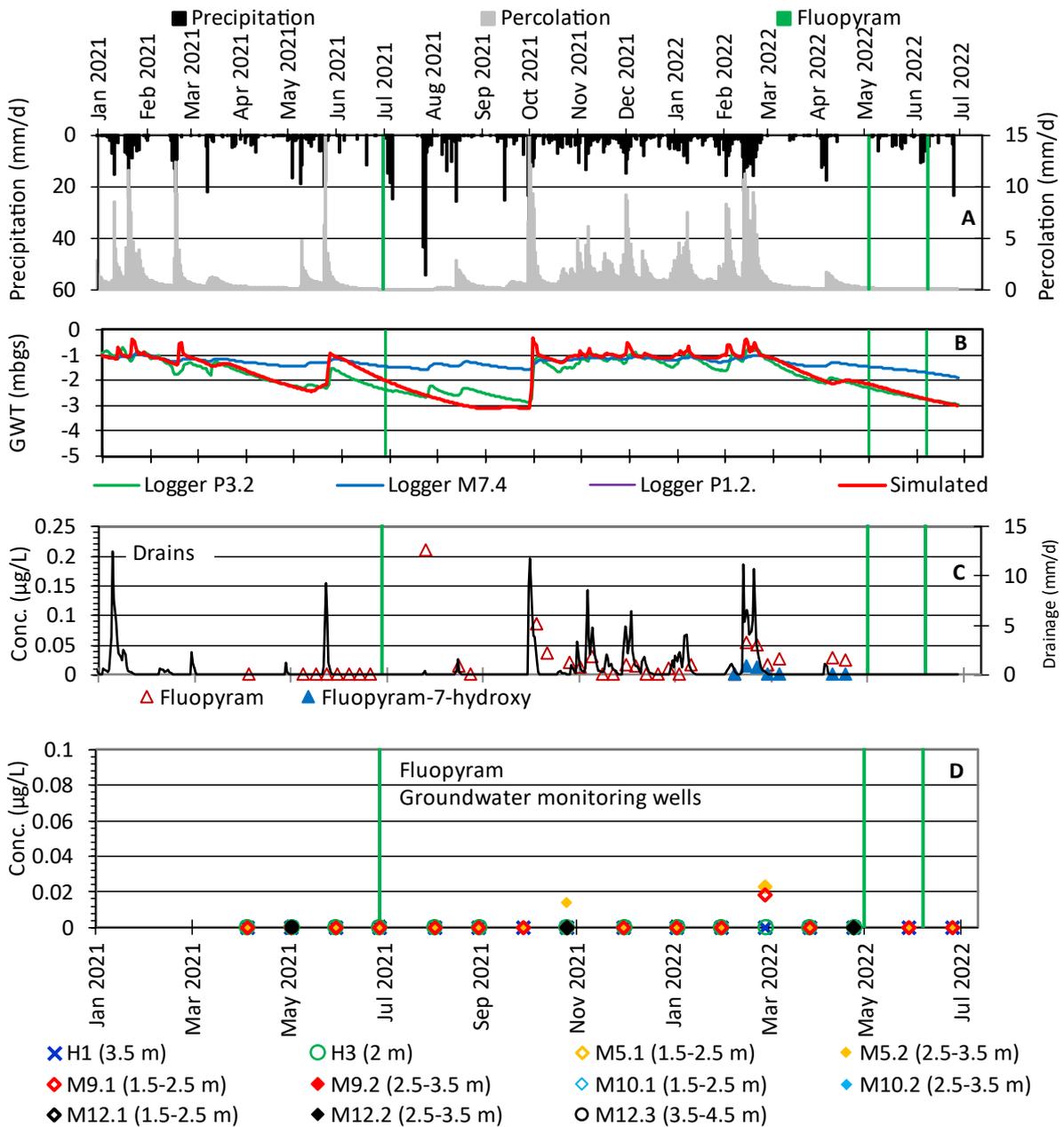


Figure 6.10.1. Fluopyram and fluopyram-7-hydroxy monitoring at Silstrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); Fluopyram and fluopyram-7-hydroxy measured in the variably saturated zone (C); and fluopyram measured in horizontal and vertical groundwater monitoring wells (D). The secondary y-axis (plot C) represents the drainage flow. It is noted that M12 is regarded as an upstream monitoring well. The vertical green lines indicate the date of fluopyram applications. Fluopyram was included in the monitoring in April 2021 and fluopyram-7-hydroxy was included in the monitoring in February 2022. Monitoring of Fluopyram and fluopyram-7-hydroxy at Silstrup is ongoing.

### *Groundwater monitoring wells*

Fluopyram and fluopyram-7-hydroxy are not detected in groundwater at Jyndevad, Faardrup, and Lund. Note that the monitoring period at Jyndevad runs only from May 22 (fluopyram application date) to June 30, 2022, hence data should be interpreted as preliminary.

At Silstrup, fluopyram is detected in groundwater at two sampling events in October 2021 and March 2022. The detections of fluopyram in groundwater coincide with the two peak detections observed in drainage. Fluopyram was first detected in groundwater in a concentration  $< 0.1 \mu\text{g/L}$  in October 2021 approximately four months after the June 2021 fluopyram application (Figure 6.10.1D). Here, fluopyram was detected in the downstream well M5 (2.5-3.5 mbgs) in a concentration of  $0.014 \mu\text{g/L}$ . In March 2022, fluopyram was detected again in M5 in both 1.5-2.5 and 2.5-3.5 mbgs. Both detections were in a concentration of  $0.023 \mu\text{g/L}$ . Fluopyram was additionally detected in downstream well M9 (1.5-2.5 mbgs) in a concentration of  $0.018 \mu\text{g/L}$ . As the sampling in M9 at the depth 2.5-3.5 mbgs was half-yearly, no sample at that depth was collected in March 2022, where it was detected in M5. No fluopyram or fluopyram-7-hydroxy is detected in samples from the horizontal wells H1 and H3, and the upstream well M12 during the monitoring period.

A total of 67, 54, and 66 groundwater samples were collected from, Silstrup, Faardrup, and Lund, respectively (Table 6.10.1), during the monitoring period from May/June 2021 to June 2022, and 7 groundwater samples from Jyndevad in the period May 2022 to June 2022. Monitoring of fluopyram and fluopyram-7-hydroxy is ongoing at all four fields.

#### 6.9.4 Discussion and conclusion on the fluopyram and fluopyram-7-hydroxy monitoring

Fluopyram was tested in three different crops, rapeseed at Faardrup, spring barley at Jyndevad, Silstrup, and Lund, and winter wheat at Silstrup, Faardrup, and Lund during the monitoring period May/June 2021 - June 2022.

At Silstrup, fluopyram and the degradation product fluopyram-7-hydroxy are both detected in drainage following the application of fluopyram in spring barley in June 2021. Only fluopyram was detected in a concentration above  $0.1 \mu\text{g/L}$  ( $0.21 \mu\text{g/L}$ ) in a drainage sample approximately one month after the application. In groundwater monitoring wells downstream of the field, only fluopyram is detected at two sampling events, October 2021, and March 2022, both in concentrations  $< 0.1 \mu\text{g/L}$ . At Lund, fluopyram was detected twice (December 2021 and February 2022) and only in drainage in concentrations  $< 0.1 \mu\text{g/L}$  after the fluopyram application in winter wheat in June 2021.

Fluopyram was not detected in groundwater or drainage/water from suction cups at Jyndevad and Faardrup, and fluopyram-7-hydroxy was likewise not detected neither in groundwater nor drainage/water from suction cups at Jyndevad, Faardrup, and Lund.

The monitoring period after the fluopyram applications in June 2022 at all four fields, is still too short for a thorough evaluation and is regarded as preliminary. Monitoring of fluopyram and fluopyram-7-hydroxy is ongoing at all fields.

## 6.10 Picloram test

The fungicide picloram is monitored in the current reported monitoring period, July 2020-June 2022, following picloram application on the clay till field Lund. Detailed information on the field site is available in Chapter 2.

### 6.10.1 Application of picloram at Lund

Picloram was tested in PLAP in connection with cropping of winter rapeseed at Lund in December 2019, and picloram was applied on December 17, 2019. Detailed information on agricultural management is available in Chapter 3, Appendixes 3 and 7, and previous PLAP reports.

Picloram was not applied in PLAP prior to the test initiated at Lund in 2019.

### 6.10.2 Compounds included in the monitoring

Picloram was selected for monitoring starting in November 2019 at Lund and continued until December 2021 when the monitoring ended. No degradation products were included in the monitoring.

### 6.10.3 Results of the picloram monitoring

Picloram was introduced in the monitoring in November 2019 and applied on December 17, 2019, at Lund. In total, 13 background samples were collected in drainage and monitoring wells, before the picloram application and none of these contained picloram.

An overview of the entire monitoring is given in Table 6.11.1 and shows the number of detections in water from drainage and monitoring wells during the monitoring period from June 2018 to October 2020.

*Table 6.11.1. Number of samples (n) and detections of picloram at Lund in drainage (D), and vertical monitoring wells (M). The counting comprises all samples collected from December 17, 2019 to December 2021. Background samples collected before the application of picloram are not included in the counting.*

	Total			D			M			H*			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Lund</b>	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Picloram</b>	149	2	0	21	1	0	128	1	0	-	-	-	128	1	0

\*No horizontal monitoring well is installed at Lund.

#### *Variably saturated zone and groundwater monitoring wells*

A total of 21 and 128 samples were collected from drainage and groundwater monitoring wells, respectively at Lund in connection with the picloram test from December 2019 to December 2021. Picloram was detected in one drainage sample in January 2020 (0.011 µg/L) approximately one month after the application. In groundwater, picloram was also detected once. This was in a sample from the monitoring well M1 (upstream well) in May 2021 (0.053 µg/L).

### 6.10.4 Discussion and conclusion on the picloram monitoring

Picloram was tested in winter rapeseed at Lund in December 2019 and was not detected in water from drainage and groundwater before the picloram application. Picloram was after the application detected once in a drainage sample (0.011 µg/L) approximately one month after application, and once in groundwater from the upstream well M1 in May 2021 (0.053 µg/L). Picloram was included in the monitoring in November 2019 and the monitoring ended in December 2021.

As the bromide tracer test done at Lund in 2017, seemed to have been erroneous, the hydraulic connectivity of the screens and the groundwater is yet unclear. It is therefore not known if the upstream well M1 is in hydraulic contact with water percolating from the field or not. This also affects the interpretation of the downstream wells, where the lack of picloram detections might be a consequence of lacking hydraulic connectivity (refer to Chapter 5.5). Hence data should be interpreted as preliminary and picloram is listed for retesting, when possible, according to crop rotation. The water dynamics at Lund are presently under evaluation and a new bromide tracer experiment will be conducted.

## 6.11 Propyzamide test

The herbicide propyzamide and two degradation products, RH-24644 and RH-24580, were monitored in the current monitoring period, July 2020-June 2022, following propyzamide applications at the three clay till fields, Silstrup, Faardrup, and Lund. Detailed information on the field sites included in the test is available in Chapter 2.

### 6.11.1 Application of propyzamide at Silstrup, Faardrup, and Lund

Propyzamide was tested in PLAP in connection with cropping of winter rapeseed during 2020-2022. Propyzamide was applied in winter rapeseed on November 9, 2018 at Silstrup, on December 17, 2019 at Lund, and on November 25, 2020 at Faardrup. Detailed information on agricultural management is available in Chapter 3, Appendixes 3 and 7, and previous PLAP reports.

Propyzamide was previously applied at Silstrup in 2005, at Tylstrup in 2007, and at Faardrup in 2007 and 2013. The results from these propyzamide applications are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk)

### 6.11.2 Compounds included in the monitoring

In the 2018 and 2020 propyzamide tests at Silstrup and Faardrup, respectively, only propyzamide was included in the monitoring, but in connection with the 2019 propyzamide test at Lund, the degradation products, RH-24644 and RH-24580, were additionally included in the monitoring together with propyzamide.

Monitoring of propyzamide was initiated in October 2018 and 2020 at Silstrup and Faardrup, respectively. Monitoring of propyzamide, RH-24644, and RH-24580 was initiated at Lund in October 2019.

Monitoring of propyzamide ended in Silstrup in February 2021 and monitoring of propyzamide and the two degradation products at Lund ended in September 2021. Monitoring of propyzamide at Faardrup is ongoing.

### 6.11.3 Results of the propyzamide, RH-24644, and RH-24580 monitoring

At Silstrup, propyzamide was introduced in the monitoring in October 2018 and propyzamide was applied on November 9, 2018. In total, 12 samples were collected in drainage and monitoring wells before the propyzamide application, and none of these contained propyzamide.

At Faardrup, propyzamide was introduced in the monitoring in October 2020 and propyzamide was applied on November 25, 2020. In total, 7 samples were collected in monitoring wells before the propyzamide application, and none of these contained propyzamide.

At Lund, propyzamide and RH-24644, and RH-24580 were introduced in the monitoring in October 2019 and propyzamide was applied on December 17, 2019. In total, 20 samples were collected in drainage and monitoring wells before the propyzamide application and neither of these contained propyzamide nor the two degradation products.

An overview of the entire monitoring is given in Table 6.12.1 and shows the number of detections in drainage and monitoring wells during the monitoring period from November 9, 2018 to February 2021 at Silstrup, from December 17, 2019 to September 2021, at Lund, and from November 25, 2020 to June 2022 at Faardrup.

Table 6.12.1. Number of samples and detections of propyzamide at Silstrup and Faardrup, and propyzamide and the two degradation products, RH-24644 and RH-24580 at Lund in drainage (D), vertical monitoring wells (M) and horizontal wells (H). The counting comprises all samples collected from November 9, 2018 to February 2021 at Silstrup, from December 17, 2019 to September 2021, at Lund and from November 25, 2020 to June 2022 at Faardrup. Background samples collected before the application of propyzamide are not included in the counting.

	Total			D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Silstrup</b>															
Propyzamide	217	33	10	58	15	6	112	10	4	47	8	0	159	18	4
<b>Faardrup</b>															
Propyzamide	114	6	2	36	5	2	60	0	0	18	1	0	78	1	0
<b>Lund</b>															
Propyzamide	129	11	3	18	9	3	111	2	0	-*	-*	-*	111	2	0
RH-24644	129	2	1	18	2	1	111	0	0	-*	-*	-*	111	0	0
RH-24580	129	0	0	18	0	0	111	0	0	-*	-*	-*	111	0	0

\* No horizontal monitoring well is installed at Lund.

### Silstrup

#### Variably saturated zone

At Silstrup, propyzamide was sprayed on winter rapeseed in November 2018 and five days after application a drainage concentration of 5.1 µg/L was found (Figure 6.12.1C). Note that the datapoint in Figure 6.12.1C is plotted at 0.5 µg/L. This detection is observed following five days of precipitation (in total 37 mm) coinciding with a rise in measured groundwater level in logger P3.2 as well as simulated groundwater levels above the tile drain level, and the initiation of a drainage event of approximately 13 mm (Figure 6.12.1A-C). One week after the high concentration of propyzamide was detected, a subsequent drainage event occurred, but the analysis of the collected drainage sample was unfortunately erroneous and was omitted. Further, another period of precipitation followed and caused yet another drainage event. In this drainage sample, from December 2018, the propyzamide concentration was 0.38 µg/L. Thereafter concentrations declined gradually, except in one sample from February 2019, where yet another drainage event resulted in a concentration of 0.38 µg/L. Between February and August 2019, propyzamide concentrations fluctuated in concentrations < 0.05 µg/L, and from September 2019 until February 2021 there were no further detections in drainage. Between the application of propyzamide in November 2018 and the end of drainage in February 2021, a total of 58 drainage samples were collected, 15 contained propyzamide, and six with a concentration > 0.1 µg/L (Table 6.12.1).

#### Groundwater monitoring wells

At Silstrup, propyzamide was in addition to the detections in drainage also detected in the groundwater (Figures 6.12.1D-E), both from the horizontal wells (H1 and H3) and from downstream monitoring wells (M5 and M9). These, detections in the groundwater coincided with detections in drainage, but at lower concentration levels. In total, 98 groundwater samples were collected from M5, M9, and M10, where 10 samples contained propyzamide, four had concentrations > 0.1 µg/L with the highest concentration (0.22 µg/L) detected in February 2019. 47 groundwater samples were collected from the horizontal wells (H1 and H3), and here eight contained propyzamide, but none with concentrations > 0.1 µg/L. Propyzamide was not detected in any of the 14 groundwater samples from the upstream well M12. This supports that the propyzamide used in the field caused the detections in both drainage and groundwater. In summary, the propyzamide application on winter rapeseed in November 2018 led to detections in 18 out of 159 groundwater samples, four in concentrations > 0.1 µg/L. The exceedance of the groundwater limit value was

observed in the groundwater monitoring well M5 in the three sampling events immediately after the propyzamide application (equivalent to approximately three months). At the next sampling event in March 2019, detections in concentrations  $< 0.1 \mu\text{g/L}$  were made, and no samples hereafter contained propyzamide (Figures 6.12.1D-E). Monitoring of propyzamide at Silstrup ended in February 2021.

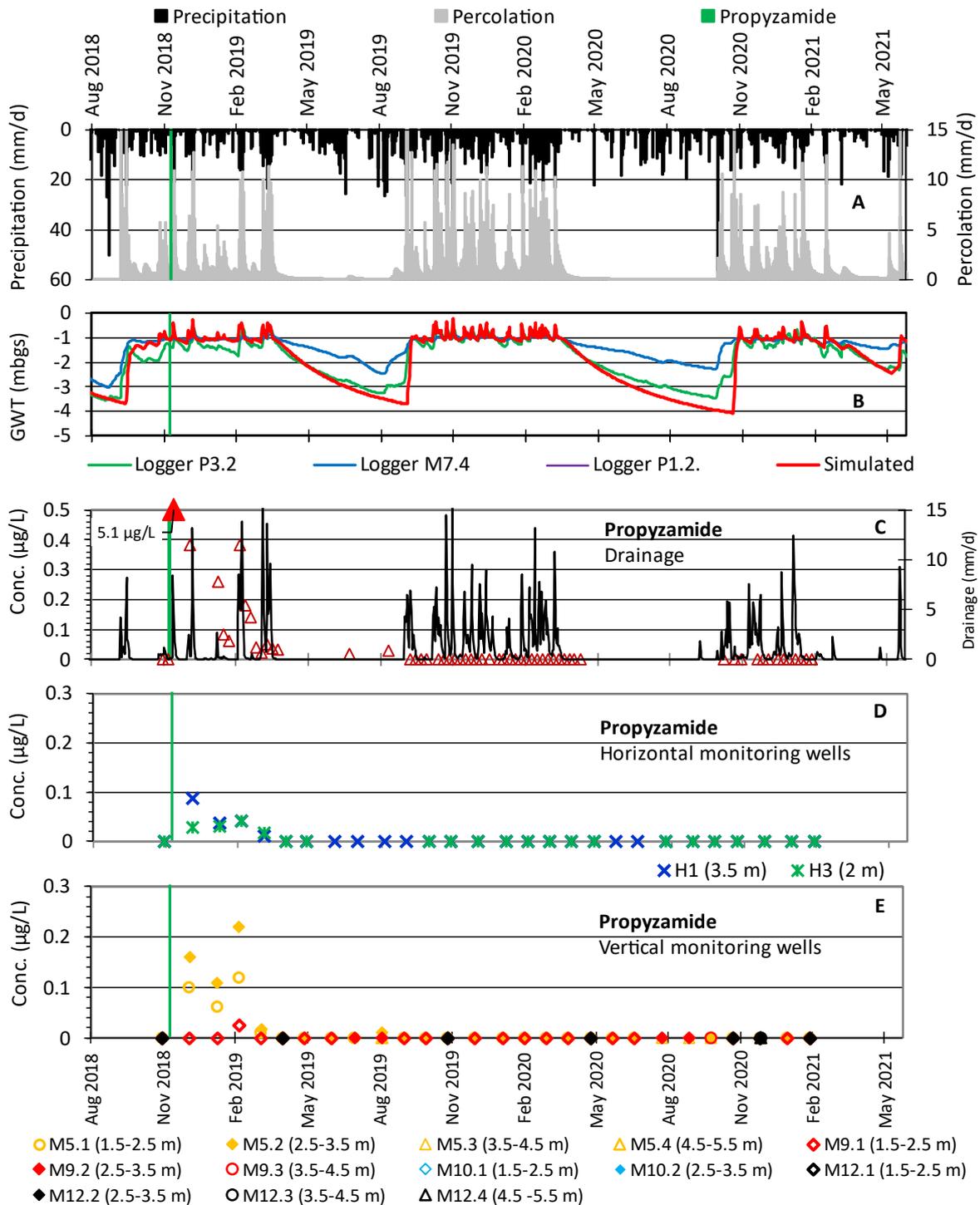


Figure 6.12.1. Propyzamide monitoring at Silstrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); propyzamide measured in the variably saturated zone (C); and groundwater in horizontal wells (D); and vertical wells (E). The secondary y-axis (plot C) represents the drainage flow. It is noted that M12 is regarded as an upstream monitoring well.

*The vertical green lines indicate the date of propyzamide application. Note that the propyzamide concentration on November 14, 2018, is 5.1 µg/L. This concentration is higher than the plot range in (C) and thus the data point is represented as a solid red triangle at 0.5 µg/L. Propyzamide was included in the monitoring in October 2018 and the monitoring of propyzamide at Silstrup ended in February 2021.*

### *Faarstrup*

#### *Variably saturated zone*

At Faarstrup, propyzamide was applied on November 25, 2020, after which no drainage occurred until the end of January 2021. Propyzamide was detected in drainage for the first time in February 2021, approximately two months after the application in a concentration of 7.0 µg/L (note the datapoint in Figure 6.12.2C is plotted at 0.5 µg/L). Hereafter, propyzamide was detected in decreasing concentrations until April 2021, where it was lastly detected in a concentration of 0.013 µg/L. The drainage stopped in August 2021 and did not reoccur until January 2022. No propyzamide was detected in the second period with drainage flow from January 2022 to July 2022, although a large drainage event occurred in February-March 2022 (Figure 6.12.2C). Propyzamide was detected in five of 36 drainage samples with two samples in a concentration > 0.1 µg/L.

#### *Groundwater monitoring wells*

At Faarstrup, propyzamide was detected only in one of 78 groundwater samples. This was in a sample collected in March 2021 (0.067 µg/L), from the horizontal well H2 (Figure 6.12.2D, 3.5 mbgs). The detection of propyzamide in the groundwater coincided with the maximum propyzamide concentration (7 µg/L) detected in drainage approximately two months after the propyzamide application. Due to the low groundwater table in March 2021, no sample was available in the second horizontal well H3 (2.5 mbgs). Propyzamide is not detected in any of the monitoring wells, M4, M5, and M6, and upstream well M2 during the monitoring period. It is noted that no samples were collected from October 2021 to January 2021, due to constraints related to Covid-restrictions. Monitoring of propyzamide at Faarstrup is ongoing.

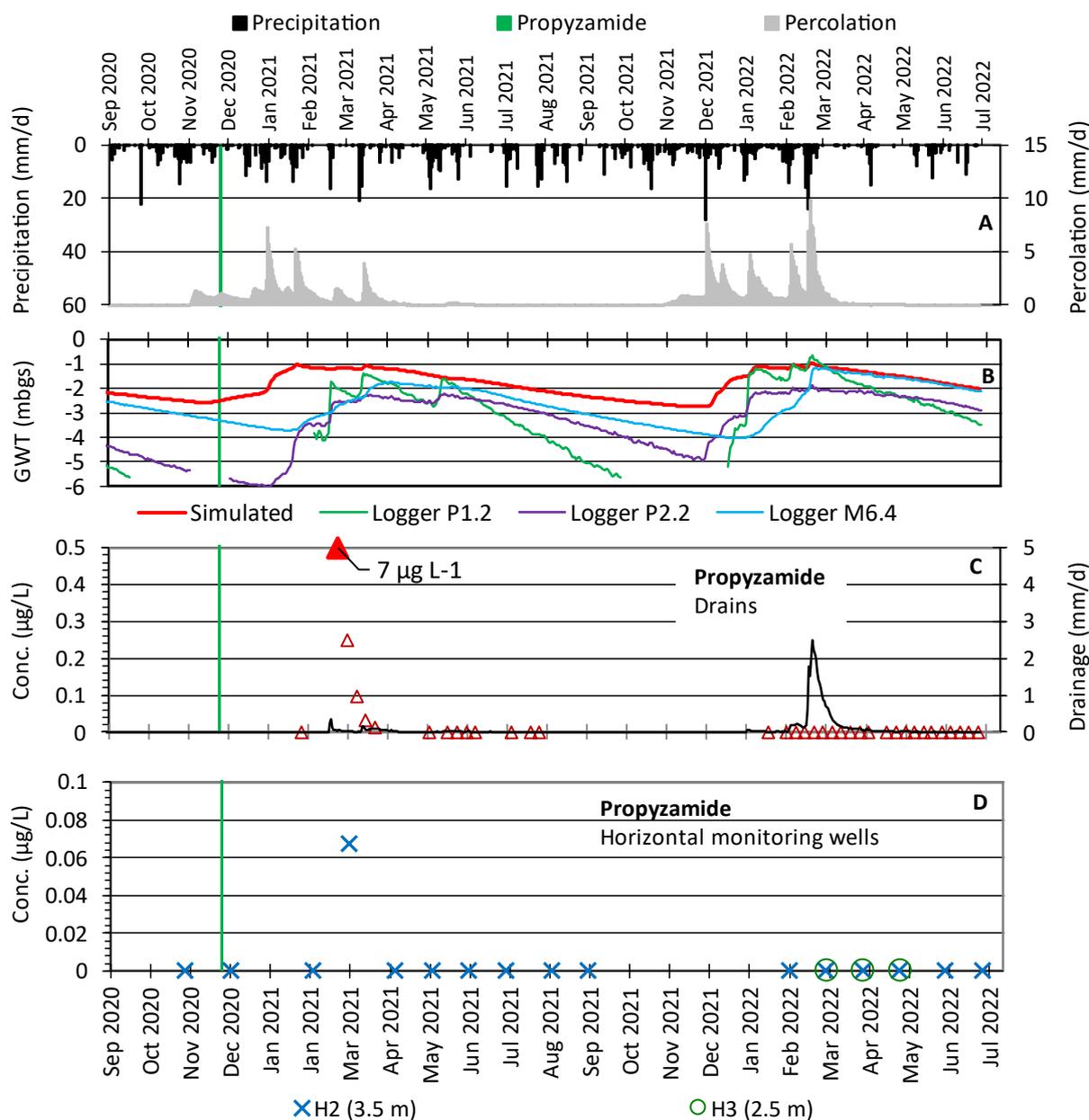


Figure 6.12.2. Propyzamide monitoring at Faardrup. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); propyzamide measured in the variably saturated zone (C) and groundwater in horizontal wells (D). The secondary y-axis (C) represents the drainage flow. The vertical green lines indicate the date of propyzamide application. Note that the measured propyzamide concentration on February 24, 2021, is 7.0 µg/L. This concentration is higher than the plot range in (C) and thus the data point is represented as a solid red triangle at 0.5 µg/L. Propyzamide was included in the monitoring in October 2020 and the monitoring of propyzamide at Faardrup is ongoing.

## Lund

### Variably saturated zone

Following the propyzamide application on December 17, 2019, at Lund, propyzamide was detected in samples from all three drainage events present in December 2019, and January and February 2020 (Figure 6.12.3C). The first propyzamide detection was three days after the application in a concentration of 0.13 µg/L. The maximum detected propyzamide concentration in drainage was 0.41 µg/L on January 15, 2020, approximately one month after the application. Propyzamide was detected in nine of 18 drainage samples

with three samples in a concentration > 0.1 µg /L (Figure 6.12.3C, Table 6.12.1). With the propyzamide application in December 2019, the two degradation products, RH-24644 and RH-24580 were included in the monitoring. Only RH-24644 was detected in drainage and it was only detected in two samples out of 18. These two detections of RH-24644 coincided with the first two propyzamide detections in December 2019, shortly after the application (Figure 6.12.3D). RH-24644 was detected in a concentration > 0.1 µg/L (0.11µg/L) in the drainage sample taken three days after propyzamide application in December 2019 (Figure 6.12.3D).

#### *Groundwater monitoring wells*

Propyzamide was detected in two groundwater samples from Lund out of 111, both detections in a concentration < 0.1 µg/L. These detections coincided with the highest detections observed in drainage (0.41 and 0.13 µg/L in January and February 2020, respectively). The two detections were both from the monitoring well M1, located upstream of the field (Figure 6.12.3E).

The degradation products RH-24644 and RH-24580 were not detected in any of the 111 groundwater samples. Monitoring of propyzamide and the two degradation products ended in September 2021.

#### 6.11.4 Discussion and conclusion of the propyzamide, RH-24644, and RH-24580 monitoring

Propyzamide was tested in winter rapeseed at Silstrup from October 2018 to February 2021 and at Lund from October 2019 to September 2021. At Faardrup the test was initiated in October 2020 and is still ongoing.

Propyzamide was detected in drainage in concentrations > 0.1 µg/L at all three fields. At Silstrup, propyzamide was detected during the first coming drainage event after the propyzamide application. This was five days after application and propyzamide was detected in a concentration of 5.1 µg/L. A similar trend was observed at Faardrup where propyzamide was detected in a high concentration (7.0 µg/L) at the first coming drainage event after the propyzamide application (two months after application). Propyzamide was also detected in drainage right after application at Lund but at a lower concentration level. The first detection of propyzamide was here three days after application (0.13 µg/L), whereas the maximum concentration (0.41 µg/L) was detected approximately one month later. The two degradation products, RH-24644 and RH-24580, were both included in the monitoring at Lund. Only RH-24644 was detected in drainage and it was detected twice concomitantly with the detections of propyzamide immediately after the propyzamide application. One of these detections was in a concentration > 0.1 µg/L (0.11µg/L). It is noted that the winter rapeseed BBCH stage was 13 at the time of the propyzamide application at Lund, while it should have been at stage 15. This means, that the plant cover was smaller, and could affect the leaching pattern. However, a similar pattern of immediate propyzamide leaching approximately at the first coming drainage event after the propyzamide application was also observed at Silstrup (Figure 6.12.1) and Faardrup (Figure 6.12.2). Further, a pattern of compounds leaching to drainage at the first coming drainage event after a pesticide application is commonly observed at the clay till fields in PLAP (e.g., sections 6.5 Azoxystrobin, 6.7 Cycloxydim, and 6.9 Florasulam). Therefore, it is likely that RH-24644 leaching to drainage would still occur at the first coming drainage event after propyzamide application at a BBCH stage of 15.

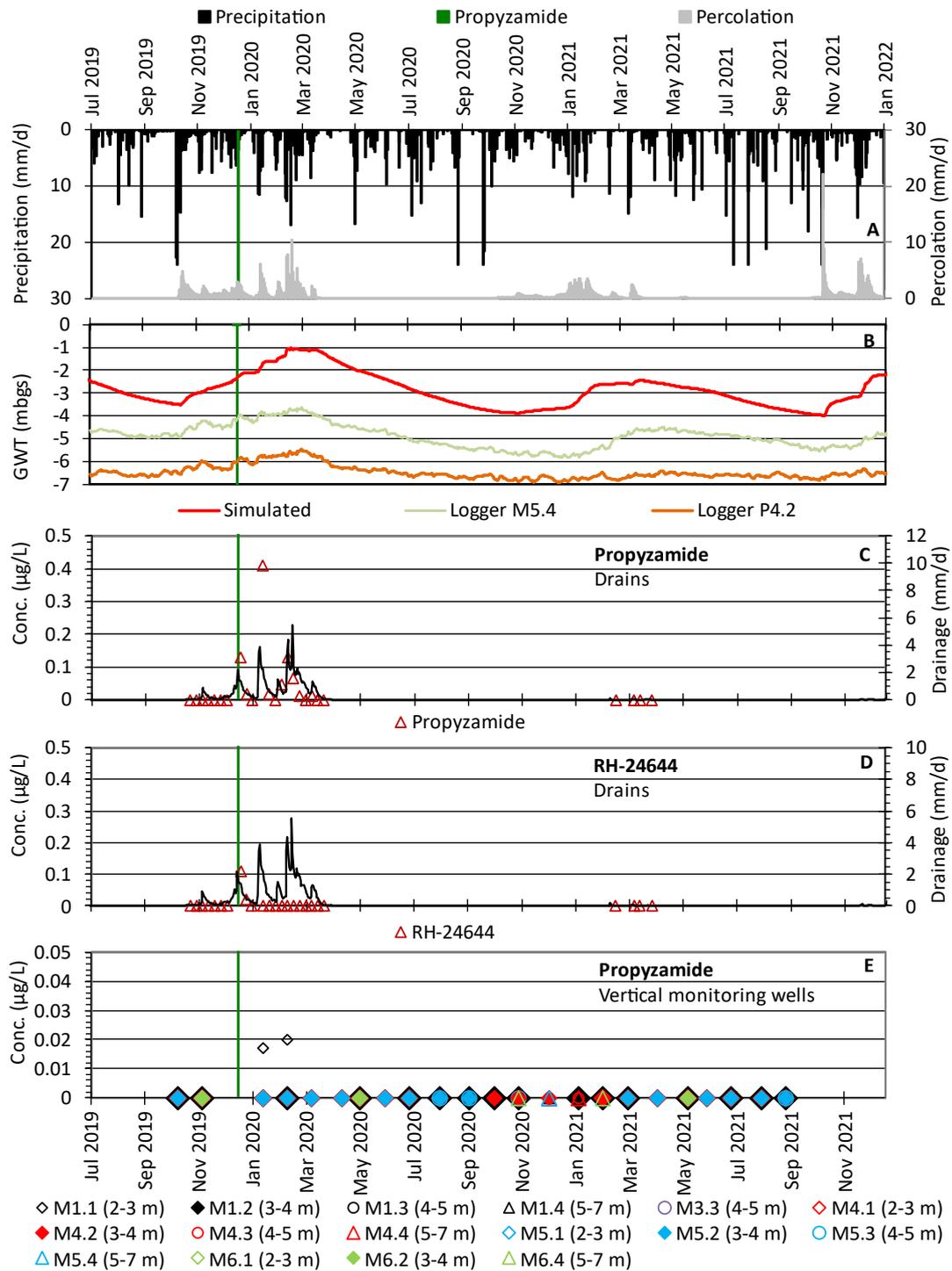


Figure 6.12.3. Propyzamide and RH-24644 monitoring at Lund. Precipitation and simulated percolation 1 mbgs (A); measured and simulated groundwater level (B); propyzamide and RH-24644 measured in the variably saturated zone (C-D) and propyzamide measured in groundwater from vertical wells (E). The secondary y-axis (plot C-D) represents the drainage flow. It is noted that M1 is regarded as an upstream monitoring well. The vertical green lines indicate the date of propyzamide application. Propyzamide, RH-24644, and RH-24580 were included in the monitoring in October 2019 and monitoring of propyzamide at Lund ended in December 2021.

As the bromide test done at Lund in 2017, seems to have been erroneous, the hydraulic connectivity of the screens and the groundwater is yet unclear. It is therefore not known if the upstream well M1 is in hydraulic contact with water percolating from the field. This also affects the interpretation of the downstream wells, where the lack of propyzamide detections might be a consequence of lacking hydraulic connectivity (refer to Chapter 5.5). Hence data should be interpreted as preliminary. The water dynamics at Lund are presently under evaluation and a new bromide tracer experiment was conducted in January 2023.

Propyzamide was detected in groundwater from all three fields, but only at Silstrup in a concentration  $> 0.1 \mu\text{g/L}$ . The leaching of propyzamide is generally observed with the first drainage event after application. Also, detections of propyzamide in groundwater coincided with detections in drainage at all three fields, although the concentration magnitude was lower.

In conclusion, propyzamide is both leached to drainage, within the first drainage event after the propyzamide application, and to groundwater at the three clay till fields included in the test, Silstrup, Faardrup, and Lund. Drainage sample concentrations exceeding  $0.1 \mu\text{g/L}$  occurred at all fields, but concentrations decreased rapidly and only at Silstrup was the limit value exceeded in groundwater approximately three months after application after which no more detections were made.

## 6.12 Proquinazid test

Two degradation products, IN-MM671 and IN-MM991 from the fungicide proquinazid, were monitored in the current monitoring period, July 2020-June 2022, following proquinazid applications on the sandy field Jynde vad, and the clay till field Faardrup. Detailed information on the field sites included in the test is available in Chapter 2.

### 6.12.1 Application of proquinazid at Jynde vad and Faardrup

Proquinazid was tested in PLAP in connection with cropping of winter rye and spring barley during 2020-2022. Proquinazid was applied in winter rye in April and May 2019 at Jynde vad, and in spring barley twice in June 2019 at Faardrup. Detailed information on agricultural management is available in Chapter 3, Appendices 3 and 7.

Proquinazid was not applied in PLAP prior to the tests at Jynde vad and Faardrup in 2019.

### 6.12.2 Compounds included in the monitoring

Two degradation products, IN-MM671 and IN-MM991, from proquinazid were selected for monitoring at Jynde vad and Faardrup. The monitoring started in April 2019 and ended in March 2021 in both fields.

Monitoring of the two degradation products started in April 2019, but no analytical methods for the analysis of IN-MM671 and IN-MM991 were available at that time. Consequently, the water samples collected from April to September 2019 were stored at -20°C (refer to Chapter 7) after which the analytical method was ready, and the samples were analysed. The effect of storing the samples is currently unknown but relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). Overall, 48 and 41 of 235 and 152 samples collected from Jynde vad and Faardrup, respectively, were stored before analysis.

### 6.12.3 Results of the IN-MM671 and IN-MM991 monitoring

At Jynde vad, proquinazid was applied on April 25, and May 9, 2019. In total, 13 samples were collected in suction cups and monitoring wells before the proquinazid application and none of these contained any of the two degradation products. The Jynde vad field was irrigated twice in April before the proquinazid application, and six times in the monitoring period from April 25 to March 2021, when the monitoring ended. The irrigation samples were analysed for IN-MM671 and IN-MM991, but none were detected either before the application or during the monitoring period.

At Faardrup, proquinazid was applied on June 3 and 7, 2019. In total, 26 background samples were collected in drainage and monitoring wells before the first proquinazid application on June 3, and none of these contained any of the two degradation products.

An overview of the entire monitoring is given in Table 6.13.1 and shows the number of detections in water from suction cups (Jynde vad), drainage, and monitoring wells during the monitoring period after proquinazid applications on April 25, 2019, at Jynde vad and on June 3, 2019, at Faardrup to the end of March 2021, where the monitoring ended.

Table 6.13.1. Number of samples and detections of IN-MM671 and IN-MM991 at Jynde vad and Faardrup in suction cups/drainage (S/D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from April 25, 2019 to March 2021 at Jynde vad, and from June 3, 2019, to March 2021 at Faardrup. Background samples collected before the application of proquinazid and irrigation water samples are not included in the counting.

	Total			S*/D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	N	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Jynde vad</b>															
IN-MM671	222	0	0	46*	0	0	165	0	0	11	0	0	176	0	0
IN-MM991	222	0	0	46*	0	0	165	0	0	11	0	0	176	0	0
<b>Faardrup</b>															
IN-MM671	125	0	0	35	0	0	68	0	0	22	0	0	90	0	0
IN-MM991	125	0	0	35	0	0	68	0	0	22	0	0	90	0	0

\*data from suction cups at Jynde vad.

#### Variably saturated zone and groundwater monitoring wells

The content of the proquinazid degradation products, IN-MM671 and IN-MM991 in water from the variably saturated zone (drainage and water from suction cups) and in groundwater was monitored at Jynde vad and Faardrup after proquinazid applications in April and June 2019, respectively. A total of 46 and 35 samples were collected from suction cups and drainage, and 176 and 90 samples from the groundwater at Jynde vad and Faardrup, respectively, in the period after application and until the end of the monitoring period in March 2021 (Table 6.13.1). The two degradation products were neither detected in any of the collected drainage samples from the variably saturated zone nor in the groundwater samples. The monitoring ended on March 10 and 24, 2021 at Jynde vad and Faardrup, respectively.

#### 6.12.4 Discussion and conclusion on the IN-MM671 and IN-MM991 monitoring

Proquinazid was in 2019 tested in two different crops, winter rye at Jynde vad and in spring barley at Faardrup. Two proquinazid degradation products, IN-MM671 and IN-MM991 were included in the monitoring. None of the degradation products are detected in water from the suction cups, drainage, groundwater, or irrigation water, neither in the period before the proquinazid applications (April/June 2019) nor in the monitoring period from April/June 2019 to March 2021, where the monitoring ended at both fields. In conclusion, the two proquinazid degradation products, IN-MM671 and IN-MM991 did not give rise to groundwater detections above the limit value during a two-year monitoring period at the sandy field Jynde vad and clay till field Faardrup.

## 6.13 Propaquizafop test

Four degradation products, CGA 287422, CGA 294972, CGA 290291, and PPA from the herbicide propaquizafop, were monitored in the current monitoring period, July 2020-June 2022, following propaquizafop application on the clay till field Silstrup. Detailed information on the field site included in the test is available in Chapter 2.

### 6.13.1 Application of propaquizafop at Silstrup

Propaquizafop was tested in PLAP in connection with cropping of winter rapeseed and applied in April 2019 at Silstrup. Detailed information on agricultural management is available in Chapter 3, Appendixes 3, and 7.

Propaquizafop was not applied in PLAP prior to the tests at Silstrup in 2019.

### 6.13.2 Compounds included in the monitoring

Four degradation products, CGA 287422, CGA 294972, CGA 290291, and PPA from propaquizafop, were selected for monitoring at Silstrup. The collection of samples for monitoring started in April 2019 and the monitoring ended in December 2021. No analytical methods for analyses of CGA 287422, CGA 294972, CGA 290291, and PPA were available when the monitoring was planned to start. Consequently, the water samples collected from April to December 2019 were stored at -20°C (refer to Chapter 7 in Badawi *et al.* 2022, available at [www.plap.dk](http://www.plap.dk)) after which the analytical method was ready, and the samples were analysed. The effect of storing the samples is currently unknown but relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). A total of 59 of 266 samples were stored before analysis.

It should be noted that the analytical methods for analyses of the four degradation products have different quantification limits. The quantification limits are 0.01 µg/L, 0.05 µg/L, 0.01 µg/L, and 0.02 µg/L for CGA 287422, CGA 294972, CGA 290291, and PPA, respectively.

### 6.13.3 Results of the CGA 287422, CGA 294972, CGA 290291, and PPA monitoring

Propaquizafop was applied on April 9, 2019, at Silstrup, and samples for monitoring of the four degradation products were collected from April 4. In total, 10 background samples were collected in monitoring wells before the propaquizafop application. As the groundwater table was below the drain depth no drainage samples were available for measuring the background content of CGA 287422, CGA 294972, CGA 290291, and PPA. However, none of the groundwater samples contained any of the four degradation products before the propaquizafop application.

An overview of the entire monitoring is given in Table 6.14.1 and shows the number of detections in water from drainage and monitoring wells during the monitoring period after the propaquizafop application from April 2019 to December 29, 2021.

Table 6.14.1. Number of samples and detections of CGA 287422, CGA 294972, CGA 290291, and PPA at Silstrup in drainage (D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from April 9, 2019, to December 29, 2021. Background samples collected before the application of propaquizafop are not included in the counting.

	Total			D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	N	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Silstrup</b>															
<b>CGA-287422</b>	256	0	0	73	0	0	129	0	0	54	0	0	183	0	0
<b>CGA-294972</b>	256	0	0	73	0	0	129	0	0	54	0	0	183	0	0
<b>CGA-290291</b>	256	0	0	73	0	0	129	0	0	54	0	0	183	0	0
<b>PPA</b>	257	0	0	74*	0	0	129	0	0	54	0	0	183	0	0

\*One drainage sample was erroneously only analysed for PPA and not CGA 287422, CGA 294972, and CGA 290291 as planned.

#### Variably saturated zone and groundwater monitoring wells

The content of the propaquizafop degradation products, CGA 287422, CGA 294972, CGA 290291, and PPA in water from drainage and groundwater was monitored at Silstrup after the propaquizafop application in April 2019. A total of 73 (PPA, 74) samples were collected from drainage and 183 samples were collected from the groundwater from April 2019 to December 29, 2021 (Table 6.14.1). The four degradation products were not detected in any of the collected samples, neither from the variably saturated zone nor the groundwater.

#### 6.13.4 Conclusion of the CGA 287422, CGA 294972, CGA 290291, and PPA monitoring

Propaquizafop was tested in winter rapeseed at Silstrup in 2019-2021. Four propaquizafop degradation products, CGA 287422, CGA 294972, CGA 290291, and PPA were included in the monitoring. None of the degradation products were detected in water from drainage or groundwater, neither in the period before the propaquizafop application in April 2019 (10 samples) nor in the monitoring after the application to December 2021 (256 samples), where the monitoring ended. In conclusion, the four propaquizafop degradation products, CGA 287422, CGA 294972, CGA 290291, and PPA did not give rise to groundwater detections above the limit value during a two-year monitoring period at the clay till field Silstrup.

## 6.14 Pyroxsulam test

Five degradation products, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide from pyroxsulam, are monitored in the current monitoring period, July 2020-June 2022, following pyroxsulam applications on the two clay till fields Silstrup and Estrup. Detailed information on the field sites included in the test is available in Chapter 2.

### 6.14.1 Application of pyroxsulam at Silstrup and Estrup

Pyroxsulam was tested in connection with cropping of winter wheat in the period 2020-2022. Pyroxsulam was applied to winter wheat on April 7, 2020 at Silstrup and on May 3, 2020 at Estrup. Detailed information on agricultural management is available in Chapter 3, Appendices 3 and 7, and previous PLAP reports ([www.plap.dk](http://www.plap.dk)). Pyroxsulam was not applied in the PLAP fields before the applications at Silstrup and Estrup in 2020.

### 6.14.2 Compounds included in the monitoring

Five degradation products from pyroxsulam, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide were selected for monitoring starting in April 2020 at Silstrup and Estrup.

Monitoring of the two degradation products started in April 2020, but no analytical methods for the analysis of the five degradation products were available at that time. Consequently, the water samples collected from April to October 2020 were stored at -20°C (refer to Chapter 7) after which the analytical method was ready, and the samples were analysed. The effect of storing the samples is currently unknown but relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). Overall, 33 of 193 samples collected at Silstrup, and 30 of 186 samples collected at Estrup were stored before analysis.

Monitoring of the five degradation products, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide was done from April and May 2020 to March 2022 at both the Silstrup and Estrup fields, respectively.

### 6.14.3 Results of the PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide monitoring

Four days before the pyroxsulam application at Estrup, background samples were collected in the horizontal well (H1) and the monitoring wells (M1, M4, M5, M6). Nine samples were collected and none of these contained any of the four degradation products.

At Silstrup, one background sample was collected in drainage the day before application and none of the five degradation products were detected.

An overview of the entire monitoring is given in Table 6.15.1 and shows the number of detections in drainage and monitoring wells during the monitoring period from April 7, 2020 at Silstrup, and May 3, 2020 at Estrup to March 2022.

Table 6.15.1. Number of samples and detections of PSA, 6-Cl-7-OH-pyroxulam, 5-OH-pyroxulam, 7-OH-pyroxulam and pyridine sulfonamide at Silstrup and Estrup in drainage (D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from April 7, 2020 at Silstrup and May 3, 2020 at Estrup to March 2022. Background samples collected before the pyroxulam applications are not included in the counting.

	Total			D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Silstrup</b>															
PSA	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
6-Cl-7-OH-pyroxulam	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
5-OH-pyroxulam	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
7-OH-pyroxulam	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
pyridine sulfonamide	192	0	0	50	0	0	100	0	0	42	0	0	142	0	0
<b>Estrup</b>															
PSA	177	0	0	68	4	2	68	0	0	41	0	0	109	0	0
6-Cl-7-OH-pyroxulam	177	0	0	68	0	0	68	0	0	41	0	0	109	0	0
5-OH-pyroxulam	177	1	0	68	1	0	68	0	0	41	0	0	109	0	0
7-OH-pyroxulam	177	1	0	68	1	0	68	0	0	41	0	0	109	0	0
pyridine sulfonamide	177	0	0	68	0	0	68	0	0	41	0	0	109	0	0

#### Variably saturated zone

None of the five degradation products, PSA, 6-Cl-7-OH-pyroxulam, 5-OH-pyroxulam, 7-OH-pyroxulam, and pyridine sulfonamide were detected in drainage at Silstrup. At Estrup, 6-Cl-7-OH-pyroxulam and pyridine sulfonamide were not detected in drainage, but the three degradation products, PSA, 5-OH-pyroxulam, and 7-OH-pyroxulam were detected during the monitoring period from May 2020 to June 2022.

PSA was detected in four drainage samples from Estrup (Figure 6.15.1, Table 6.15.1), with two detections > 0.1 µg/L. The maximum PSA concentration (0.25 µg/L) was detected in July 2020, approximately two months after the pyroxulam application in May 2020. Thereafter, PSA was detected in three drainage samples with decreasing concentrations until September 2020, where the compound was last detected in a concentration of 0.025 µg/L. Hence, for nearly 1.5 years from October 2000 until the last drainage event in March 2022, no drainage detections were made.

The degradation products, 5-OH-pyroxulam, and 7-OH-pyroxulam were detected once during the monitoring period. This was in the drainage sample from Estrup in July 2021, where PSA was detected at the maximum concentration. 5-OH-pyroxulam and 7-OH-pyroxulam were detected (0.042 and 0.04 µg/L, respectively), approximately two months after the application of pyroxulam in April 2020.

A total of 50 and 68 drainage samples were collected from Silstrup and Estrup, respectively (Table 6.15.1).

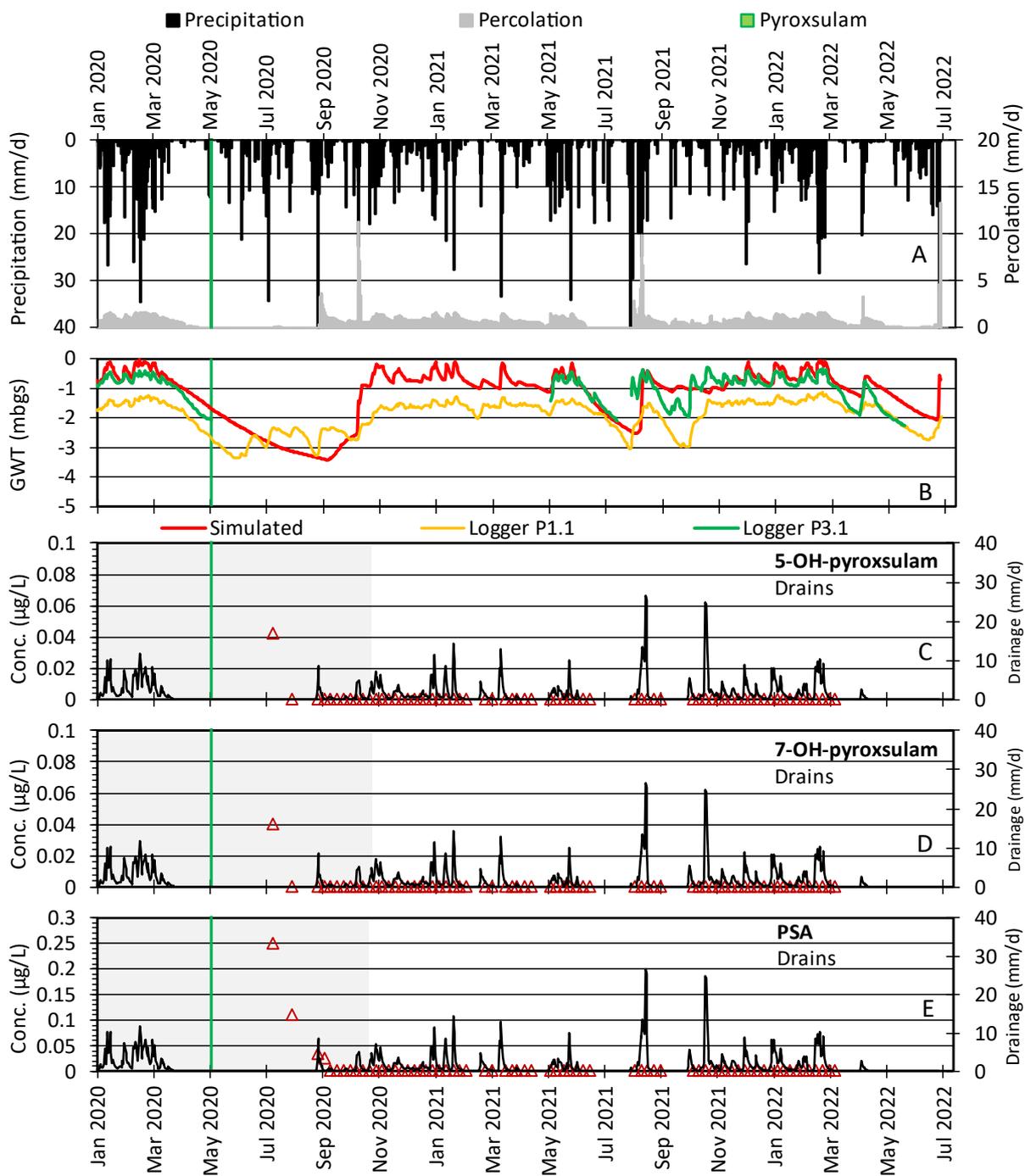


Figure 6.15.1. 5-OH-pyroxsulam, 7-OH-pyroxsulam, and PSA monitoring at Estrup. Precipitation and simulated percolation 1 mbs (A); measured and simulated groundwater level (B); 5-OH-pyroxsulam, 7-OH-pyroxsulam, and PSA measured in the variably saturated zone (C-E); The secondary y-axis (plot C-E) represents the drainage flow. Note different values on the y-axes. The vertical green lines indicate the date of the pyroxsulam application. The gray shaded areas delineate periods, where samples were stored at -20°C before analysis. Pyroxsulam was included in the monitoring in April 2021 and the monitoring of 5-OH-pyroxsulam, 7-OH-pyroxsulam, and PSA ended in March 2022.

#### *Groundwater monitoring wells*

The five pyroxsulam degradation products, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide are neither detected in groundwater at Silstrup nor Estrup.

The monitoring of PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide ended in March 2022 at Silstrup and Estrup. A total of 142 and 109 groundwater samples were collected from Silstrup and Estrup, respectively, during the monitoring period from April/May 2020 to March 2022 (Table 6.15.1).

#### **6.14.4 Discussion and conclusion on the PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide monitoring**

Pyroxsulam was tested in winter wheat at both Silstrup and Estrup from April/May 2020 to March 2022. None of the five included degradation products, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide were detected in groundwater at neither Silstrup nor Estrup. However, PSA, 5-OH-pyroxsulam, and 7-OH-pyroxsulam are detected in drainage at Estrup, but only PSA was detected in concentrations  $> 0.1 \mu\text{g/L}$  (Figure 6.15.1E, max. concentration  $0.25 \mu\text{g/L}$ ). These PSA detections were in two drainage samples approximately two months after the pyroxsulam application in May 2020. 6-Cl-7-OH-pyroxsulam and pyridine sulfonamide were not detected in drainage at any of the fields. In conclusion, the monitoring of PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide from the pyroxsulam tests shows that these degradation products do not leach into the groundwater. Although detected in a few drainage samples, the monitored degradation products seem to be removed (eg. further transformed or sorbed) before reaching the groundwater.

Monitoring of the five degradation products, PSA, 6-Cl-7-OH-pyroxsulam, 5-OH-pyroxsulam, 7-OH-pyroxsulam, and pyridine sulfonamide at Silstrup and Estrup ended in March 2022 after two years of monitoring.

## 6.15 Thifensulfuron-methyl test

Three degradation products, IN-B5528, IN-JZ789, and IN-L9223 from the sulfonylurea herbicide thifensulfuron-methyl, were monitored in the current monitoring period, July 2020-June 2022, following thifensulfuron-methyl application on the clay till field Estrup. Detailed information on the field site included in the test is available in Chapter 2.

### 6.15.1 Application of thifensulfuron-methyl at Estrup

Thifensulfuron-methyl was tested in PLAP in connection with cropping of spring barley and perennial ryegrass during 2020-2022. Thifensulfuron-methyl was applied in spring barley in June 2021 and perennial ryegrass in July 2022 at Estrup. Detailed information on agricultural management is available in Chapter 3, Appendices 3 and 7.

Thifensulfuron-methyl was previously applied at both Estrup and Silstrup in 2015 and 2016. The results from these thifensulfuron-methyl applications are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk).

### 6.15.2 Compounds included in the monitoring

Three degradation products, IN-B5528, IN-JZ789, and IN-L9223 from thifensulfuron-methyl, were selected for monitoring at Estrup. The monitoring started in April 2021 and the monitoring is still ongoing.

The degradation product IN-B5528 is a common degradation product from the sulfonylurea herbicides, thifensulfuron-methyl, tribenuron-methyl, iodosulfuron-methyl, and metsulfuron-methyl, and others. In the EFSA conclusions on the sulfonylurea herbicides, IN-B5528 is also mentioned under the synonym AE F154781. Although several of the mentioned sulfonylurea herbicides were previously applied in PLAP, IN-JZ789 and IN-L9223 were not previously included in the monitoring. IN-B5528 was included in the monitoring at Jyndevad, Silstrup, Faardrup, and Lund in connection with tribenuron-methyl applications in April/May 2022 (refer to section 6.18 – tribenuron-methyl test).

Triazinamin (EFSA synonyms, IN-A4098 and AE F059411), another common degradation product from thifensulfuron-methyl, tribenuron-methyl, and others, were included in the monitoring in connection with the 2016 applications of thifensulfuron-methyl at Estrup and Silstrup (refer to previous reports available online, [www.plap.dk](http://www.plap.dk)).

### 6.15.3 Results of the IN-B5528, IN-JZ789, and IN-L9223 monitoring

Thifensulfuron-methyl was first applied on June 1, 2021, and again on July 19, 2022, at Estrup. The degradation products, IN-B5528, IN-JZ789, and IN-L9223 were included in the monitoring in April 2021, and in total 20 background samples were collected in drainage and monitoring wells before the 2021 thifensulfuron-methyl application. None of these samples contained any of the three degradation products.

An overview of the entire monitoring is given in Table 6.16.1 and shows the number of detections in water from drainage and monitoring wells during the monitoring from June 1, 2021 to June 30, 2022.

Table 6.16.1. Number of samples and detections of IN-B5528, IN-JZ789, and IN-L9223 at Estrup in drainage (D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from June 1, 2021 to July 2022. Background samples collected before application of thifensulfuron-methyl are not included in the counting.

	Total			D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	N	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Estrup</b>															
<b>IN-B5528</b>	100	0	0	35	0	0	40	0	0	25	0	0	65	0	0
<b>IN-JZ789</b>	100	0	0	35	0	0	40	0	0	25	0	0	65	0	0
<b>IN-L9223</b>	100	0	0	35	0	0	40	0	0	25	0	0	65	0	0

#### *Variably saturated zone and groundwater monitoring wells*

The content of the thifensulfuron-methyl degradation products, IN-B5528, IN-JZ789, and IN-L9223 in water from drainage and groundwater was monitored at Estrup after the thifensulfuron-methyl application in June 2021 and July 2022. A total of 35 samples were collected from drainage and 65 samples were collected from the groundwater after the first application in 2021 until June 30, 2022 (Table 6.16.1). The three degradation products were not detected in any of the collected samples, neither from the variably saturated zone nor in the groundwater. The monitoring is ongoing.

#### 6.15.4 Discussion and conclusion of the IN-B5528, IN-JZ789, and IN-L9223 monitoring

During 2021-2022, thifensulfuron-methyl was tested in two different crops, spring barley, and perennial ryegrass at Estrup. Three thifensulfuron-methyl degradation products, IN-B5528, IN-JZ789, and IN-L9223 were included in the monitoring. None of the degradation products are detected in water from drainage or groundwater, neither in the period before the thifensulfuron-methyl application (April-June 2021) nor in the monitoring period from June 2021 to June 30, 2022. In conclusion, IN-B5528, IN-JZ789, and IN-L9223 do not give rise to groundwater detections above the limit value during the present monitoring period. However, the monitoring is ongoing, and a final evaluation will be presented in the following PLAP report .

## 6.16 Thiophanat-methyl test

From the fungicide thiophanate-methyl, one degradation product, carbendazim was monitored in the current reported monitoring period, July 2020-June 2022, following thiophanate-methyl application on the sandy field Jynde vad and clay till field Estrup. Detailed information on the field site is available in Chapter 2.

### 6.16.1 Application of thiophanate-methyl at Jynde vad and Estrup

Thiophanate-methyl was tested in PLAP in connection with cropping of winter wheat at Jynde vad and Estrup in 2018. Thiophanate-methyl was applied at both Jynde vad and Estrup on June 6, 2018. Detailed information on agricultural management is available in Chapter 3, appendices 3 and 7, and previous PLAP reports.

Thiophanate-methyl was not applied in PLAP prior to the tests initiated in 2018.

### 6.16.2 Compounds included in the monitoring

One degradation product, carbendazim, from thiophanate-methyl, was selected for monitoring starting in May 2018 at Jynde vad and Estrup and ending in October 2020.

Monitoring of the degradation product started in May 2018, but the analytical method for analysis of carbendazim was not ready. Consequently, the water samples collected from May to October 2018 were stored at -20°C (refer to Chapter 7) after which the analytical method was ready. The effect of storing the samples is currently unknown but relatively unstable compounds may degrade during storage leading to underestimation of concentration magnitudes (e.g., Lyytikäinen *et al.* 2003). In the following, it is clearly stated which samples were stored, and overall, merely 54 of 298 samples at Jynde vad and 18 of 168 samples at Estrup were stored before analysis.

### 6.16.3 Results of the carbendazim monitoring

Carbendazim was introduced in the monitoring in May 2018 and the thiophanate-methyl application was on June 6, 2018, at both Jynde vad and Estrup. In total, 15 background samples were collected in suction cups and monitoring wells at Jynde vad, and 10 samples were collected in drainage and groundwater at Estrup, before the thiophanate-methyl applications, and none of these contained carbendazim.

Water used for irrigation of the Jynde vad field was also analysed for carbendazim. Ten irrigation water samples were collected from May 2018 to October 2020 and carbendazim was not detected in any of the irrigation water samples.

An overview of the entire monitoring is given in Table 6.17.1 and shows the number of detections in water from suction cups, drainage, and monitoring wells during the monitoring period from June 2018 to October 2020.

Table 6.17.1. Number of samples (n) and detections of carbendazim at Jynde vad and Estrup in suction cups (Jynde vad only) and drainage (S/D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from June 6, 2018 to October 2020. Background samples collected before the application of thiophanate-methyl and irrigation water samples (Jynde vad only) are not included in the counting.

	Total			S*/D			M			H			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Jynde vad</b>															
<b>Carbendazim</b>	283	0	0	58*	0*	0*	214	0	0	11	0	0	225	0	0
<b>Estrup</b>															
<b>Carbendazim</b>	158	3	0	63	3	0	56	0	0	39	0	0	95	0	0

\*data from suction cups at Jynde vad

#### Suction cups, drainage, and groundwater monitoring wells

A total of 58 and 225 samples were collected from suction cups and groundwater monitoring wells, respectively, at Jynde vad, and 63 and 95 samples from drainage and groundwater monitoring wells, respectively, at Estrup in connection with the thiophanate-methyl tests from June 2018 to October 2020 (Table 6.17.1). Carbendazim was not detected in any of the collected samples at Jynde vad neither in water from the variably saturated zone (suction cups) nor in groundwater. At Estrup, carbendazim was detected in three drainage samples collected in February and March 2019. All detections were in concentrations < 0.1 µg/L (0.01-0.015 µg/L). Carbendazim was not detected in groundwater during the monitoring period.

#### 6.16.4 Conclusion of the carbendazim monitoring

Thiophanate-methyl was tested in winter wheat at Jynde vad and Estrup in 2018. The degradation product, carbendazim was detected in three drainage samples at Estrup, all in concentrations < 0.1 µg/L. The compound was not detected in any other samples collected from the suction cups, drainage, groundwater, or irrigation water, neither in the period before the thiophanate-methyl applications (May 2018) nor in the monitoring period from June 2018 to the end of monitoring in October 2020 at Jynde vad and Estrup.

## 6.17 Tribenuron-methyl test

Three degradation products, IN-B5528, IN-R9805, and M2 from the sulfonylurea herbicide tribenuron-methyl, were monitored in the current monitoring period, July 2020-June 2022, following tribenuron-methyl applications on the sandy field Jyndeved, and the three clay till fields Silstrup, Faardrup, and Lund. Detailed information on the field sites included in the test is available in Chapter 2.

### 6.17.1 Application of tribenuron-methyl at Jyndeved, Silstrup, Faardrup, and Lund

Tribenuron-methyl was tested in PLAP in connection with cropping of spring barley and winter wheat during 2020-2022. Tribenuron-methyl was applied in spring barley in April and May 2022 at Jyndeved and Lund, respectively, and in winter wheat in April 2022 at Silstrup and Faardrup. Detailed information on agricultural management is available in Chapter 3, Appendices 3 and 7.

Tribenuron-methyl was previously applied at Jyndeved in 1999, at Tylstrup in 2000 and 2006, at Silstrup in 2001, at Faardrup in 2002, and at Estrup in 2010. The results from the tribenuron-methyl applications from 1999-2010 are described in previous PLAP reports available at [www.plap.dk](http://www.plap.dk).

### 6.17.2 Compounds included in the monitoring

Three degradation products, IN-B5528, IN-R9805, and M2 from tribenuron-methyl, were selected for monitoring at Jyndeved, Silstrup, Estrup, and Lund. The monitoring started in February 2022 at all four fields and is still ongoing.

The degradation product IN-B5528 is a common degradation product from the sulfonylurea herbicides, tribenuron-methyl, iodosulfuron-methyl, thifensulfuron-methyl, and metsulfuron-methyl. In the EFSA conclusions on these sulfonylurea herbicides, IN-B5528 is also mentioned under the synonym AE F154781. Several of the mentioned sulfonylurea herbicides were previously applied in PLAP, but IN-R9805 and M2 were not previously included in the monitoring. IN-B5528 was included in the monitoring at Estrup in connection with the thifensulfuron-methyl application in April 2021 (refer to section 6.16 – thifensulfuron-methyl test).

### 6.17.3 Results of the IN-B5528, IN-R9805, and M2 monitoring

In 2022, IN-B5528, IN-R9805, and M2 were included in the monitoring in February 2022 at all four fields, Jyndeved, Silstrup, Faardrup, and Lund.

At Jyndeved, tribenuron-methyl was applied on April 23, 2022. In total, 29 background samples were collected in suction cups and monitoring wells before the tribenuron-methyl application and none of these contained any of the three degradation products. The Jyndeved field was not irrigated in the period before the tribenuron-methyl application, but it was irrigated five times from April 23 to July 1, 2022. The irrigation samples were analysed for content of IN-B5528, IN-R9805, and M2, but none were detected.

At Silstrup, Faardrup, and Lund, tribenuron-methyl was applied on April 29, 21, and May 10, 2022, respectively. Before the tribenuron-methyl applications, background samples were collected from drainage and monitoring wells for measuring IN-B5528, IN-R9805, and M2. A total of 32 background samples were collected at Silstrup, 25 at Faardrup, and 37 at Lund, and none of these samples contained any of the three degradation products.

An overview of the entire monitoring is given in Table 6.18.1 and shows the number of detections in water from suction cups (Jynde vad), drainage, and monitoring wells during the monitoring period after tribenuron-methyl applications, April/May 2022 to July 1, 2022.

Table 6.18.1. Number of samples and detections of IN-B5528, IN-R9805, and M2 at Jynde vad, Silstrup, Faardrup and Lund in suction cups/drainage (S/D), vertical monitoring wells (M), and horizontal wells (H). The counting comprises all samples collected from April 22, 2022 at Jynde vad, April 29, 2022 at Silstrup, April 21, 2022 at Faardrup, and May 10, 2022 at Lund to July 2022. Background samples collected before the application of tribenuron-methyl are not included in the counting.

	Total			S <sup>A</sup> /D			M			H*			Total Groundwater (M+H)		
	n	Det.	>0.1 µg/L	N	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L	n	Det.	>0.1 µg/L
<b>Jynde vad</b>															
IN-B5528	22	0	0	4 <sup>A</sup>	0	0	16	0	0	2	0	0	18	0	0
IN-R9805	22	0	0	4 <sup>A</sup>	0	0	16	0	0	2	0	0	18	0	0
M2	22	0	0	4 <sup>A</sup>	0	0	16	0	0	2	0	0	18	0	0
<b>Silstrup</b>															
IN-B5528	8	0	0	0	0	0	6	0	0	2	0	0	8	0	0
IN-R9805	8	0	0	0	0	0	6	0	0	2	0	0	8	0	0
M2	8	0	0	0	0	0	6	0	0	2	0	0	8	0	0
<b>Faardrup</b>															
IN-B5528	30	0	0	10	0	0	16	0	0	4	0	0	20	0	0
IN-R9805	30	0	0	10	0	0	16	0	0	4	0	0	20	0	0
M2	30	0	0	10	0	0	16	0	0	4	0	0	20	0	0
<b>Lund</b>															
IN-B5528	7	0	0	1	0	0	6	0	0	-*	-*	-*	6	0	0
IN-R9805	7	0	0	1	0	0	6	0	0	-*	-*	-*	6	0	0
M2	7	0	0	1	0	0	6	0	0	-*	-*	-*	6	0	0

<sup>A</sup>data from suction cups at Jynde vad. \*No horizontal monitoring well is installed at Lund.

#### Variably saturated zone and groundwater monitoring wells

The degradation products, IN-B5528, IN-R9805, and M2 from tribenuron-methyl were monitored in samples from the variably saturated zone (drainage and water from suction cups) and groundwater at Jynde vad, Silstrup, Faardrup, and Lund after tribenuron-methyl applications in April/May 2022. A total of 4, 0, 10, and 1 samples were collected from suction cups/drainage and 18, 8, 20, and 6 from the groundwater at Jynde vad, Silstrup, Faardrup, and Lund, respectively, after the tribenuron-methyl applications to June 30, 2022 (Table 6.18.1). The three degradation products were not detected in any of the collected samples, neither from the variably saturated zone nor in the groundwater. The monitoring is ongoing in all four fields.

#### 6.17.4 Discussion and conclusion on the IN-B5528, IN-R9805, and M2 monitoring

Tribenuron-methyl was in 2022 tested in two different crops, spring barley at Jynde vad and Lund, and winter wheat at Silstrup and Faardrup. Three tribenuron-methyl degradation products, IN-B5528, IN-R9805, and M2 were included in the monitoring. None of these were detected in water from the suction cups, drainage, groundwater, or irrigation water, neither in the period before the tribenuron-methyl application (April/May 2022) nor in the monitoring period from April/May 2022 to June 30, 2022. However, the monitoring period after the tribenuron-methyl applications in April/May 2022, at all four fields, to the end of the reporting period on June 30, 2022, is too short for a thorough evaluation and data should be interpreted as preliminary.

Monitoring of the three degradation products, IN-B5528, IN-R9805, and M2 is ongoing at all four fields, Jydevad, Silstrup, Faardrup, and Lund.

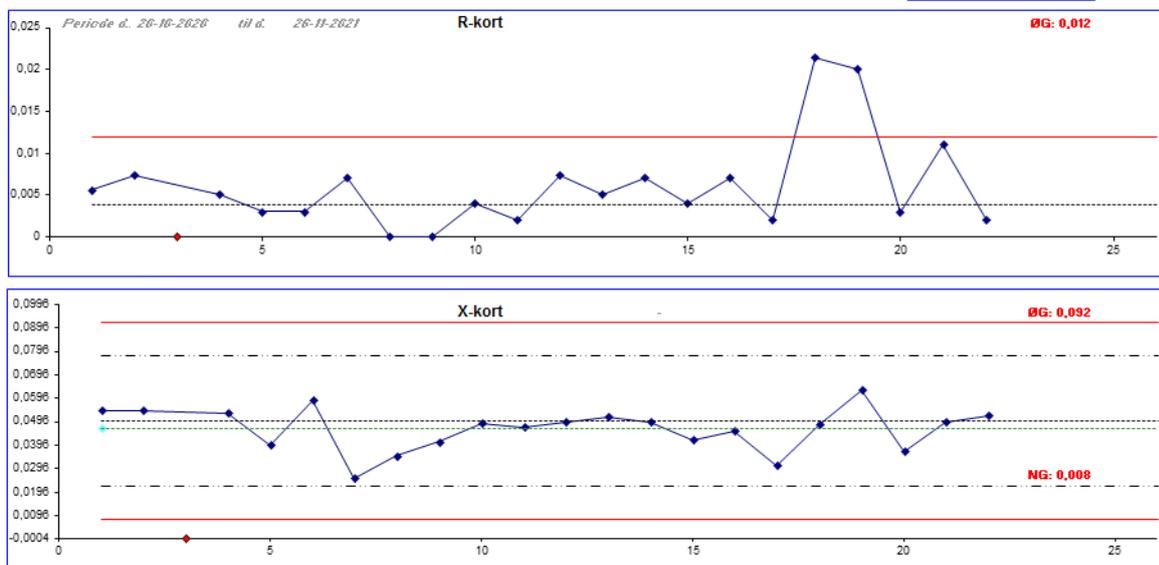
## 7. Pesticide quality assurance

Reliable results and scientifically valid methods of analysis are essential for the integrity of the present monitoring programme. Consequently, the field monitoring work is supported by intensive quality assurance entailing continuous evaluation of the analyses employed. Two types of samples are used in the quality control, 1) samples with known pesticide composition and concentration are used for *internal monitoring* of the laboratory method (internal QC), and 2) *externally spiked samples* that are used to incorporate additional procedures such as sample handling, transport, and storage (external QC). Pesticide analysis quality assurance (QA) data for the period July 2020 to June 2022 are presented below, while those for the preceding monitoring periods are presented in previous monitoring reports (available at [www.plap.dk](http://www.plap.dk)).

All pesticide analyses were carried out at a commercial laboratory selected based on a competitive EU tender. To assure the quality of the analyses, the call for tenders included requirements as to the laboratory's quality assurance (QA) system comprising both an internal and an external control procedure.

### 7.1 Internal QA – commercial laboratory

With each batch of samples, the laboratory analysed at least two control samples at two concentration levels (low QC 0.03 µg/L or 0.05 µg/L, and high QC 3 µg/L) prepared in-house at the laboratory as part of their standard method of analysis. For daily quantification of batches 5-point calibration curves within the concentration interval 0.01 µg/L to 0.2 µg/L are used. All analytical methods used in the monitoring programme have detection limits (LD, no distinction between lower limit of detection or quantification) in the range of 0.01-0.05 µg/L (except PPA; 0.05 µg/L). For each compound included in the monitoring period from July 1, 2020, to June 30, 2022, a QC report is available from the laboratory and included in Appendix 6. Figure 7.1.1 is an example of the control charts included in the QC reports. The control chart is used to study how the analytical method performs and changes over time. In the chart, the central line represents the average, and the upper and lower lines are the upper and lower control limits, respectively. The upper chart (R-kort) shows the difference between the two QC replicates on a given day. The lower chart (X-kort) is the daily average concentration of the replicates. The table below the charts shows the method statistics: limit of detection (LD, green recalculated, yellow limit), calculated recovery (% Genf.), standard deviation within ( $S_w$ ) and between day ( $S_b$ ), and the total standard deviation ( $S_t$ ), the coefficient of variance (CV%), the absolute (µg/L, limit 0.05 µg/L in drinking water) and relative (in %) uncertainty and the number of duplicate QC-samples (Par) included in the charts.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	0,05
S	0,02	93	0,00575	0,00823	0,010	21,6	0,022	46	1	21	-	0,01	0,05

Evalueringens bemærkninger (ctrl-e):

- Flere oplysninger

Genvejpotri-d eller ctrl-n næste

Periode d.: 20-10-2020 til d. 26-11-2021  
Evalueringsperiode 01-07-2019 til 30-12-2021  
Antal punkter 21  
Antal udeladte 1

Figure 7.1.1. Example of a QC chart from the external laboratory. R-kort depicts the difference between the two replicates on a given day. X-kort depicts the daily average of the replicates. Limit of detection (LD, green: recalculated, yellow: limit), calculated recovery (% Genf.), standard deviation within (Sw) and between day (Sb), and the total standard deviation (St), the coefficient of variance (CV%), the absolute (Uabs, µg/L, limit 0.05 µg/L in drinking water) and relative (Urel, in %) uncertainty and the number of duplicate QC-samples (Par) included in the charts. QC charts for all compounds included in the monitoring are available in Appendix 6.

## 7.2 External quality control

Six times during the period February 2021 to June 2022, two external control samples (QC<sub>Low</sub> and QC<sub>High</sub>) per test field were analysed at the laboratory. At Faardrup and Lund only five control sampling events were possible as the groundwater table was too low for sampling in the wells used for control sampling in October and November 2021, respectively. No external control samples were included in the period May 2020 to February 2021 due to Covid 19 lockdown.

At the four control sampling events in 2021, standard solutions used for spiking were prepared from stock mixtures in ampoules prepared by LGC (Germany) (Table 7.2.1). New ampoules were used for each set of standard solutions.

In 2022, the procedure for external quality control was changed. Ampoules used for spiking were no longer prepared at LGC, instead, all stock solutions and mixed standard solutions (Standard-mix, equal to the ampoules) were prepared freshly for each control sampling event at the Environmental Chemistry Laboratory at GEUS. The new procedure allows for higher flexibility in the included compounds as compounds in the ampoules from LGC (mixed solutions) could only be changed once a year. Further, compounds are now stored individually in high concentration stock solutions (-20°C) instead of in ampoules with a mix of compounds in low concentrations. At the two sampling events in 2022, all high concentration stock solution and standard

mix were prepared at the Environmental Chemistry Laboratory at GEUS. All ampoules and Standard-mix were sent to the commercial laboratory for confirmation of concentrations right after use as common procedure.

Preparation of the diluted Standard-mix (Field-mix) used for preparation of control samples in the field was done two days before a control sampling day and stored cold (5°C) and dark until use. For the preparation of Field-mix, 50 µL for QC<sub>Low</sub> and 120 µL for QC<sub>High</sub> of the ampoules/Standard-mix (1000 µg/l), were pipetted into a preparation glass containing 10 mL of ultrapure water. The glass was sealed, shaken thoroughly, and shipped to the staff collecting samples at the field locations. The staff finished the preparation of the external QC samples in the field by quantitatively transferring the Field-mix to a 1.0 L measuring flask. The Field-mix in the measuring flasks was diluted with groundwater from a defined groundwater well in each field. After thorough mixing, the final external QC sample was decanted into a sample bottle like the monitoring sample bottles, labelled, and transported to the laboratory together with the true samples.

In the present reporting period, the final concentrations in the external QC samples shipped for analysis in the laboratory were 0.050 µg/L for the QC<sub>Low</sub> and 0.117 µg/L for the QC<sub>High</sub>. The compounds included in the external QC samples, their concentration in the initial ampoule/Standard-mix, and the final external QC samples sent for analysis are listed in Table 7.2.1.

Every month, field blank samples consisting only of ultra-pure HPLC water, transferred to sample flasks in the field, were included as control for false-positive findings in the external QA procedure. All samples (both spiked and blanks) included in the QA procedure were labelled with coded reference numbers so that the laboratory was unaware of which samples were external QC controls, field blanks, or true samples. A total of 45 field blank samples were included in the period from July 1, 2020, to June 30, 2022.

Table 7.2.1. Pesticides and degradation products (in italics) included in the external QC samples in the period July 1, 2020 to June 30, 2022. Ampoule concentrations in both the LGC ampoules and GEUS Standard mix and in the final high-level (QC<sub>High</sub>) and low-level (QC<sub>Low</sub>) external control samples used. Compounds in ampoules from LGC were dissolved in acetonitrile (ampoule no. 1 + 2), methanol (ampoule no. 3) and methyl tert-butyl ether (ampoule no. 4). Standard mix prepared at GEUS (ampoule no. G) were prepared in methanol. Concentrations shown for LGC ampoules are average concentrations of analysed concentration from first usage (in use from) and final usage (in use to) dates.

Compound	Ampoule concentration (µg/L)	Ampoule no.	Lot no.	In use from (date)	In use to (date)
<i>1,2,4-triazole</i>	840	4	1111022MB	01-07-2020	30-06-2021
<i>CGA290291</i>	1045	1	1-1107298AL	01-07-2020	30-06-2021
<i>CTCA</i>	1155	3	1-1107300ME	01-07-2020	30-06-2021
<i>CypM</i>	930	3	1-1107300ME	01-07-2020	30-06-2021
<i>EZ BH 517-TSO</i>	955	2	1-1107299AL	01-07-2020	30-06-2021
<i>IN-MM991</i>	1050	3	1-1107300ME	01-07-2020	30-06-2021
<i>Metconazole</i>	920	1	1-1107298AL	01-07-2020	30-06-2021
<i>N,N-DMS</i>	910	3	1-1107300ME	01-07-2020	30-06-2021
<i>picloram</i>	915	3	1-1107300ME	01-07-2020	30-06-2021
<i>Propyzamide</i>	960	1	1-1107298AL	01-07-2020	30-06-2021
<i>PSA</i>	1409	3	1-1107300ME	01-07-2020	30-06-2021
<i>TSA</i>	1400	2	1-1107299AL	01-07-2020	30-06-2021
<i>X-729</i>	880	1	1-1107298AL	01-07-2020	30-06-2021
<i>Propyzamide</i>	990	G	VAP01_01_014	26-04-2022	05-05-2022
<i>DMSA</i>	1010	G	VAP01_01_014	26-04-2022	05-05-2022
<i>Fluopyram-7-hydroxy</i>	1100	G	VAP01_01_014	26-04-2022	05-05-2022
<i>IN-B5528</i>	720	G	VAP01_01_014	26-04-2022	05-05-2022
<i>IN-JZ789</i>	3100*	G	VAP01_01_014	26-04-2022	05-05-2022
<i>IN-L9223</i>	600	G	VAP01_01_014	26-04-2022	05-05-2022
<i>IN-R9805</i>	1100	G	VAP01_01_014	26-04-2022	05-05-2022
<i>M2</i>	1500	G	VAP01_01_014	26-04-2022	05-05-2022
<i>1,2,4-triazol</i>	1100	G	VAP01_01_014	26-04-2022	05-05-2022
<i>IN-R9805</i>	1100	G	VAP01_01_014	01-03-2022	10-03-2022
<i>1,2,4-triazol</i>	1100	G	VAP01_01_014	01-03-2022	10-03-2022
<i>Fluopyram-7-hydroxy</i>	980	G	VAP01_01_014	01-03-2022	10-03-2022
<i>IN-B5528</i>	1100	G	VAP01_01_014	01-03-2022	10-03-2022
<i>IN-JZ789</i>	1400	G	VAP01_01_014	01-03-2022	10-03-2022
<i>IN-L9223</i>	870	G	VAP01_01_014	01-03-2022	10-03-2022
<i>PSA</i>	1330	G	VAP01_01_014	01-03-2022	10-03-2022
<i>DFP-TSA</i>	1080	G	VAP01_01_014	01-03-2022	10-03-2022
<i>DMSA</i>	837	G	VAP01_01_014	01-03-2022	10-03-2022
<i>TSA</i>	1100	G	VAP01_01_014	01-03-2022	10-03-2022
<i>5-OH-florasulam</i>	973	G	VAP01_01_014	01-03-2022	10-03-2022
<i>Pyridine sulfonamide</i>	1090	G	VAP01_01_014	01-03-2022	10-03-2022
<i>6-Cl-7-OH-pyroxulam</i>	1010	G	VAP01_01_014	01-03-2022	10-03-2022
<i>7-OH-pyroxulam</i>	890	G	VAP01_01_014	01-03-2022	10-03-2022
<i>DFP-ASTCA</i>	689	G	VAP01_01_014	01-03-2022	10-03-2022
<i>Propyzamide</i>	930	G	VAP01_01_014	01-03-2022	10-03-2022
<i>M2</i>	1300	G	VAP01_01_014	01-03-2022	10-03-2022

\*the Standard-mix was erroneously prepared, but the recovery in the external QC samples were corrected according to the measured concentration.

## 7.3 Results and discussion

### 7.3.1 Comments on results from the monitoring period June 2020 to July 2022

Several compounds should have been introduced in the analytical programme in April 2020, but due to delays in internal procedures regarding the selection of compounds for the monitoring programmes this year, and thus delays in both the procurement of the analytical standards and consequently analytical method development this was not possible. Consequently, samples collected in April 2020 for analysis of compounds listed in Table 7.3.1 were stored at -20°C for up to six months until the analytical methods were ready for sample analysis. As the stability of the compounds of concern when frozen for several months is unknown and according to e.g. Lyytikaäinen *et al.* 2003, pesticides may degrade during storage in water, results from these periods should be considered tentative. Currently, compound stability studies in frozen samples are planned for initiation shortly. For future need of sample storage, stability, and recovery studies in spiked samples will be set up, if possible, in parallel with the collected and stored water samples or as soon as possible thereafter. Compounds included in the monitoring in this present period July 2020 to June 2020 but originating from pesticide application in 2018-2019 are included and evaluated in the QC section in previous reports, available at [www.plap.dk](http://www.plap.dk).

*Table 7.3.1. Compounds influenced by sample storage during the monitoring period. Water samples collected in the period from initiated sampling and until initiation of analysis were stored at -20°C. Results from these periods should be considered tentative given unknown stability of the specified analytes. Samples were stored due to delays in internal procedures regarding the selection of compounds for the monitoring program, and thus delays in both the procurement of the analytical standard and consequently analytical method development. Monitored degradation products (in italics).*

Monitored compound	Pesticide under evaluation	Water sampling initiated	Analysis of stored samples initiated	Maximum storage at -20°C (months)
DMSA	Cyazofamid	01-04-2020	21-10-2020	6
DMS	Cyazofamid	01-04-2020	16-04-2020	0.5
<i>IM-1-4</i>	Acetamiprid	01-04-2020	23-10-2020	6
<i>IM-1-5</i>	Acetamiprid	01-04-2020	23-10-2020	6
PSA	Pyroxsulam	01-04-2020	21-10-2020	6
<i>6-Cl-7-OH-pyroxulam</i>	Pyroxsulam	01-04-2020	20-10-2020	6
<i>5-OH-pyroxulam</i>	Pyroxsulam	01-04-2020	23-10-2020	6
<i>7-OH-pyroxulam</i>	Pyroxsulam	01-04-2020	23-10-2020	6
<i>Pyridine sulfonamide</i>	Pyroxsulam	01-04-2020	23-10-2020	6
<i>5OH-florasulam</i>	Florasulam	01-04-2020	23-10-2020	6
<i>DFP-ASTCA</i>	Florasulam	01-04-2020	20-10-2020	6
<i>DFP-TSA</i>	Florasulam	01-04-2020	21-10-2020	6
CTCA	Cyazofamid	01-04-2020	23-10-2020	6
CCIM	Cyazofamid	01-04-2020	23-10-2020	6

### 7.3.2 Internal QA

Ideally, the analytical procedure provides precise and accurate results. However, results from the analyses are subject to a certain standard deviation. Such standard deviation may be the combined result of several contributing factors and overall, the accuracy of an analytical result reflects two types of error: Random errors related to precision and systematic errors relating to bias. In a programme like PLAP, it is relevant to consider possible changes in analytical reliability over time. As random and systematic errors may change over time, it is relevant to distinguish between standard deviations resulting from *within-day* variation as opposed to those associated with *between-day* variation in the analytical results. To this end, internal control samples are included in the analytical process as described above. Thus, by utilizing statistical analysis of the internal QA data (provided by the laboratory), it is possible to separate and estimate the different causes of the analytical variation in two categories: *between-day* variation and *within-day* variation (Funk *et al.*, 1995; Miller *et al.*, 2000). This kind of analysis can provide an extra indication of the reliability of the analytical results used in the PLAP. The statistical tool used is an analysis of variance (ANOVA) and encompasses all duplicate internal QC samples (single analyses are excluded). The analysis can be divided into three stages:

1. **Normality:** An initial test for normality is made as this is an underlying assumption for the one-way ANOVA.
2. **Between-day contribution:** In brief, this test will reveal any day-to-day contribution to the variance in the measurements. If there is none, the total standard deviation can be considered attributable to the within-day error of the analysis. For this purpose, an ANOVA-based test is used to determine if the between-day standard deviation ( $S_b$ ) differs significantly from 0 (this test is made as an F-test with the  $H_0$ : between-day mean square = within-day mean square).
3. **Calculating standard deviations:** If the F-test described above reveals a contribution from the between-day standard deviation ( $S_b$ ), it is relevant to calculate three values: The within-day standard deviation ( $S_w$ ), the between-day standard deviation ( $S_b$ ), and the total standard deviation ( $S_t$ ).

As the error associated with the analytical result is likely to be highly dependent on the compound analysed, the QA applied is compound specific. In the current reporting period, QC charts were made available by the external laboratory for 29 compounds included in the monitoring. The QC charts are presented in Appendix 6.

In the latest PLAP report covering QC for the period 2019-2020, one new pesticide (picloram) and nine degradation products (CGA287422, CGA290291, CGA294972, IN-MM671, IN-MM991, PPA, RH-24580 and RH-24644) were introduced in the analytical QA-programme. Internal QC data is reported in the previous report, available at [www.plap.dk](http://www.plap.dk).

This present report covering 2020-2022, includes monitoring of 20 new compounds, one new pesticide (fluopyram) and 19 new degradation products (5-OH-florasulam, 6-Cl-7-OH-pyroxulam, 7-OH-pyroxulam, CCIM, CTCA, DFP-ASTCA, DFP-TSA, DMS, DMSA, fluopyram-7-hydroxy, IN-B5528, IN-JZ789, IN-L9223, IN-R9805, M2, PSA, pyridine sulfonamide, TSA, X-729) in the monitoring program. QC charts for these compounds are presented in Appendix 6.

In general, data for some of the compounds rely on very few duplicate samples, either because the compound is newly introduced or because monitoring of the compound ended early in the reporting period. All methods of analysis are continuously optimized and improved.

The total standard deviations ( $S_t$ ) of the various analyses of pesticides and degradation products are within the range of 0.0022-0.012  $\mu\text{g/L}$  with the highest values observed for 6-Cl-7-OH-pyroxsulam and 7-OH-pyroxsulam (Appendix 6). In general, the data suggest that the analytical methods used for quantification of the compounds are all acceptable.

### 7.3.3 External QC samples

As described above the external QC programme was based on samples spiked in the field. As part of the quality control, a set of blank samples consisting of HPLC water was prepared in the field and analysed to evaluate the possibility of false-positive findings. From these results, it is concluded that contamination of samples during collection, storage and analysis is not likely to occur. A total of 45 blank samples were analysed and no compounds were detected in any of these analysed blank samples. Therefore, samples analysed in the monitoring programme and detected to contain pesticides and/or degradation products are regarded as true positive findings.

Table 7.3.2 provides an overview of the recovery of all externally spiked samples. Since the results for each field in Table 7.3.2 are mainly based on a few observations for each concentration level (high/low) and that each concentration level is not spiked in duplicate in the fields, the data should be interpreted with precaution and not too rigorously. In this present report, recoveries are calculated from the nominal concentration (1000  $\mu\text{g/l}$ ) in the stock solution, when the measured concentration is in the range of 900-1100  $\mu\text{g/l}$  ( $\pm 10\%$ ). For stock solutions with concentrations out of this range, the measured concentration (averaged if measured several times) is used for calculating the recovery.

The external control samples are prepared on location in the field by spiking groundwater from a selected monitoring well. The groundwater used might therefore already contain the compounds of interest. To circumvent this error, a true sample from the selected well is sent for analysis together with the QC samples. The result from this sample is used for correction of the spiked control samples and subtracted when calculating the recoveries. For the low-level QC samples in particular, a background content of a compound can still result in calculation of elevated recovery percentages due to the uncertainty of the analyses ( $U_{\text{rel}}$  30%, refer to section 7.3.2 internal QC) and the lack of replicates. For this reason, the QC data must be considered tentatively and used only to keep track of possible changes in the quality of the programme from period to period.

A total of 56 samples were spiked in this reporting period July 1, 2020- June 30, 2022. In general, the recovery of the spiked compounds was acceptable i.e. in the range of 70% to 120% and the internal QC data shows that the analytical methods are acceptable and in good control. This year, only DMS, TSA, DFP-ASTCA, IN-B5528, IN-JZ789, IN-L9223 and picloram have recoveries out of this range.

Table 7.3.2. Recovery of compounds in externally spiked control samples from the period 1.7.2020-30.6.2022. Average recovery (%) of the nominal- or measured concentration (when stock solutions deviated from  $1000 \pm 100 \mu\text{g/L}$ ) at low/high concentration levels is indicated for each field and as an average recovery from all fields (Avg. %). For each compound, no. of pairs ( $QC_{\text{Low}}/QC_{\text{High}}$ )/ $n_{\text{total}}$  refers to the number of pairs of samples with detections of the spiked compound at Low- and High-level and the total number of spiked samples (including all  $QC_{\text{Low}}$  and  $QC_{\text{High}}$  samples), respectively. Bold red font is used for recoveries outside the range of 70-120%.

Compounds	Jydevad %		Silstrup %		Estrup %		Faardrup %		Lund %		Avg. %	No. of Pairs (Low & High) / $n_{\text{total}}$
	Low	High	Low	High	Low	High	Low	High	Low	High		
1,2,4-triazole	104	103	104	102	96	88	93	83	114	89	97	28/56
5-OH-Florasulam			120	103	100	103					106	2/4
6-Cl-7-OH-pyroxulam			108	120	112	111					113	2/4
7-OH-pyroxulam			100	111	90	96					99	2/4
CGA290291			100	94							97	4/8
CTCA	99	108									104	3/6
CyPM			104	86							95	4/8
DFP-ASTCA			<b>126</b>	<b>128</b>	104	103					115	2/4
DFP-TSA			100	85	80	85					88	2/4
Fluopyram-7-hydroxy	99	98	100	103			91	103	99	98	99	8/16
IN-B5528	76	84	86	85	87	87	94	<b>65</b>	104	103	87	10/20
IN-JZ789					<b>137</b>	<b>137</b>					137	2/4
IN-L9223					<b>133</b>	<b>122</b>					127	2/4
IN-MM991	90	85					96	94			91	2/4
IN-R9805	104	115	91	82			94	88	91	94	95	8/16
M2	96	104	103	97			90	97	94	101	98	8/16
Metconazole					91	94					93	2/4
DMS	86	84									85	3/6
Picloram									<b>61</b>	75	68	2/4
Propyzamide			80	84			92	91	92	88	88	9/18
PSA			101	90	86	91					92	8/16
Pyridine sulfonamide			100	85	100	94					95	2/4
TSA			85	88	97	<b>63</b>					83	6/12
X-729					81	88			93	77	85	4/8

In 2021 at Estrup and Lund, recoveries of TSA in external QC samples were inconsistently in the range of 20-320 %. The concentration of TSA in the LGC ampoule, when used for the first time was almost double the concentration when used for the last time, suggesting that TSA is unstable in the ampoule and degrades over time, when stored in a mix for several months as was the procedure before change of procedure by 2022. However, the recoveries of TSA in the QC samples from 2021 are not decreasing over time and vary between fields. The ampoules used also contain three other florasulam degradation products that theoretically can be transformed to TSA during storage of the ampoules. In 2022 after the change of procedure, the concentration of TSA in the standard solution used for spiking was within  $\pm 10$  % of the theoretical concentration and the recoveries were within 70-120%, except for one high-level control sample at Estrup which was slightly higher (128%).

DMS was included in the external QC programme at Jyndevad in March 2021. The water used for preparation of the control samples was sampled from the upstream monitoring well M7. At the three QC sample events in 2021, no DMS was detected in the water used for spiking the QC samples. At the two control sampling events in March and May 2022, the background concentration of DMS was 0.078 and 0.15 µg/l, respectively, hence the background concentration exceeded the concentration spiked to the control samples (low 0.05 and high 0.12 µg/l) and the control samples were omitted.

DMSA was included in the external control programme at Jyndevad in March 2022. The water used for preparation of the control samples was sampled from upstream monitoring well M7. At the two control sample events in March and April 2022 the background concentration of DMSA (coming from the neighboring field, refer to Chapter 6.6 - cyazofamid) was higher (0.19 and 0.47 µg/l, respectively) than the spike concentrations and the control samples were omitted.

The recoveries of DFP-ASTCA, IN-JZ789, IN-L9223 and picloram are calculated based on only two pairs of QC samples (2 x QC<sub>low</sub> and 2 x QC<sub>High</sub>). The recovery of DFP-ASTCA is only slightly elevated at Silstrup (QC<sub>low</sub> 126% and QC<sub>High</sub> 128%), whereas the recoveries at Estrup are within the range (QC<sub>low</sub> 104% and QC<sub>High</sub> 103%). The recoveries of IN-JZ789 and IN-L9223 are only tested at the Estrup field site and all were > 120%. No background concentration of the compounds in the groundwater can explain the elevated recoveries. However, the recoveries in Table 7.3.2 are an average from the two sampling events, where at the March 2022 event the recoveries for IN-JZ789 QC<sub>low</sub> was 100% and QC<sub>High</sub> was 104%. One month later, in April 2022, the recoveries were 174% and 171%, respectively. This discrepancy between sampling events suggests that something might have gone wrong on this specific day, either in the field or in the GEUS laboratory. The concentration of IN-JZ789 in the Standard-mix used for preparing the Field-mix was at this day out of range (3100 µg/l) and although nominal concentration and recoveries were corrected accordingly, this might still influence the results. A similar pattern was observed for IN-L9223, suggesting the Standard mix from April 2022 to be the cause of error.

The recovery of picloram was in March 2021 76% in both QC<sub>low</sub> and QC<sub>High</sub> and in May 2021 the recoveries were 46% and 74%, respectively. No obvious explanation for the low recovery has been found.

The recovery of IN-B5529 was based on 10 sample pairs (10/10 QC<sub>low</sub>/QC<sub>High</sub>), two pairs from each of the five fields. Samples from all fields, except at Lund (QC<sub>High</sub> sample), had recoveries of IN-B5528 within the acceptable range. The QC<sub>High</sub> sample at Lund in March 2022 showed a recovery of 47% and one month later it was 83%. As there were only two QC<sub>High</sub> samples at this field the average recovery became < 70%. No obvious explanation for the low recovery is present, however, the total average recovery from all fields is 87%.

All compounds included in the external spiking procedure (Table 8.1) are detected in all spiked QC samples by the commercial laboratory. The internal QC charts relating to pesticides and degradation products reported here and included in the monitoring are presented in Appendix 6.

## 7.4 Summary and concluding remarks

The QC system showed that:

- All analytical methods for the included compounds are within the limits of acceptance.
- Analysis results of compounds in water samples collected in the periods defined in Table 7.3.1 should be considered tentatively as the samples were frozen before analysis (-20°C), due to delays in both the procurement of the analytical standards and consequently analytical method development in the laboratory. The influence of freezing on the quality of analyses is to be investigated.
- The low total standard deviation ( $S_t$ ) (ranging from 0.0022 to 0.012 µg/L) on the internal QC samples indicates that the reproducibility of the analyses is in general very good.
- The recovery of compounds in externally spiked samples (External QC) is generally precise (within 70 to 120% recovery) and the change of procedure in the preparation of the external QC samples has increased the precision.
- The recovery of DMS and DMSA in the external QC samples was higher than the defined criteria (recovery of 70 to 120%) in all QC samples in 2022, but the discrepancy relates to the high background content (>0.1 µg/L) of DMS and DMSA in the groundwater used for preparation of the external QC samples. The analytical methods for analysis of DMS and DMSA were in good control.
- Based on the results from analysis of blank samples, consisting of HPLC water (shipped together with the true monitoring samples), it was concluded that contamination of samples during collection, storage, and analysis was not likely to occur. No false-positive samples were detected.

## 8. Leaching results from the entire monitoring period

In this report, the evaluation of compounds comprising the full monitoring period from 1999 to July 2022 is omitted due to structural changes in the report. Likewise, the table with color-coding (Table 9.1 and 9.3 in PLAP reports covering 1999-2019) is currently being updated but will be included in the next report. A complete summary of previous monitoring data from the entire monitoring period covering 1999 to July 2019 is available in Rosenbom *et al.* 2021 (available online at [www.plap.dk](http://www.plap.dk)). As the structure of this current report is changed compared to previous reports, Chapter 7 now presents an evaluation of the pesticide tests done individually covering all fields included in the test during the period 2020-2022. The authors, therefore, advise reading Chapter 7 in this report as a continuation of Chapter 9 in the previous reports. All previous reports and associated peer-reviewed articles can be found at [www.plap.dk](http://www.plap.dk).

A summary of pesticide monitoring data from May 1999 – June 2022 from the variably saturated zone (drainage and suction cups at 1 mbgs) is presented in Table 8.1, and from groundwater in Table 8.2. A detailed description of monitoring results for each PLAP field is summarised in Appendix 5. From May 1999 to June 2022, 156 pesticides and/or degradation products (53 pesticides and 103 degradation products) were analysed in PLAP comprising five agricultural fields (ranging between 1.2 and 2.4 ha in size) cultivated with different crops.

Table 8.1. Monitoring results from 1999 to 2022 from the variably saturated zone (drainage and suction cups at 1 m depth, suction cups at Tylstrup at 2 m depth). Total number of analysed samples (n), number of samples with detections (Det.), number of samples with detections in concentrations > 0.1 µg/L and the maximum detected concentration (Max µg/L). The pesticides and degradation products are listed under Analyte. All listed pesticides are applied in PLAP, but for some, only monitoring of the degradation product(s) was included in the programme. Analytes that are included in PLAP monitoring for the first time are written in red.

Analyte	Tylstrup				Jydeved				Silstrup				Estrup				Faardrup				Lund			
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L
<b>Acetamiprid</b>																								
IM-1-4					54	0	0																	
IM-1-5					54	0	0																	
<b>Aclonifen</b>	68	0	0		43	0	0																	
<b>Amidosulfuron</b>					23	3	1	0.11	1	0	0		99	0	0									
Desmethyl-amidosulfuron					23	0	0		1	0	0													
<b>Aminopyralid</b>	91	0	0										96	0	0									
<b>Azoxystrobin</b>	95	0	0		65	0	0		188	23	1	0.11	415	141	15	1.4	107	0	0		27	3	0	0.08
CyPM	95	0	0		65	0	0		261	192	33	0.56	415	376	150	2.1	107	4	0	0.06	25	19	3	0.43
<b>Bentazone</b>	202	4	0	0.02	230	109	17	4.5	120	45	5	6.4	440	226	16	20	205	28	6	43	27	6	0	0.05
2-amino-N-isopropyl-benzamide	72	0	0		47	2	0	0.03	65	0	0		243	1	0	0.06	69	1	0	0.06				
6-hydroxy-bentazone	65	0	0		43	0	0														22	0	0	
8-hydroxy-bentazone	65	0	0		43	0	0														22	0	0	
N-methyl-bentazone	65	0	0		43	0	0														22	1	0	0.02
<b>Bifenox</b>	22	0	0		56	2	0	0.04	68	5	2	0.38	95	4	1	0.15	64	6	0	0.09				
Bifenox acid	22	0	0		53	1	0	0.1	56	20	18	4.8	105	16	10	1.9	43	18	17	8.6				
Nitrofen	22	0	0		56	0	0		68	5	3	0.34	95	0	0		64	6	1	0.16				
<b>Boscalid</b>	56	0	0																					
<b>Bromoxynil</b>	72	0	0		61	0	0		48	0	0		142	3	2	0.6	174	0	0					
<b>Chlormequat</b>					28	0	0		21	1	0	0.01	46	1	0	0.02								
<b>Clomazone</b>	82	0	0		23	0	0		19	0	0		60	0	0		85	1	1	0.28				
FMC 65317	74	0	0		23	0	0		19	0	0		60	0	0		85	1	1	0.3				
<b>Clopyralid</b>	104	2	1	0.72					79	4	3	4.09	1	0	0		32	1	0	0.08				
<b>Cyazofamid</b>	68	0	0		32	0	0																	
CCIM					54	0	0																	
CTCA					54	0	0																	
DMSA					54	11	6	2.1																
N,N-DMS					54	42	13	0.39																
<b>Cycloxydim</b>																								
BH 517-T2SO2					39	0	0		51	0	0													
EZ-BH 517-TSO					39	11	3	0.53	51	15	1	0.11												
<b>Desmedipham</b>									159	0	0						128	0	0					
EHPC									88	0	0						99	0	0					
<b>Diflufenican</b>					38	0	0		66	11	1	0.12	57	27	12	0.49								
AE-0542291					38	0	0		66	0	0		57	0	0									
AE-B107137					52	0	0		61	5	1	0.13	58	18	0	0.09								
<b>Dimethoate</b>	63	0	0		52	0	0		109	1	1	1.42	111	0	0		77	0	0					
<b>Epoxiconazole</b>	74	0	0		90	0	0		36	0	0		49	14	2	0.39	81	0	0					
<b>Ethofumesate</b>									201	20	3	0.23	126	35	8	3.36	192	15	6	12				

Analyte	Tylstrup				Jyndeved				Silstrup				Estrup				Faardrup				Lund				
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	
<b>Fenpropimorph</b>	89	0	0		79	1	0	0.04	109	0	0		106	1	0	0.01	174	0	0						
Fenpropimorph acid	73	0	0		79	0	0		109	1	0	0.02	99	0	0		174	0	0						
<b>Flamprop-M-isopropyl</b>	63	0	0						109	12	1	0.11	155	20	0	0.07	71	1	0	0.04					
Flamprop	63	0	0						106	7	0	0.1	155	13	0	0.03	77	1	0	0.09					
<b>Florasulam</b>					54	0	0						92	0	0										
5-OH-florasulam									51	0	0		68	8	1	0.35									
DFP-ASTCA									51	0	0		68	0	0										
DFP-TSA									51	0	0		68	0	0										
Florasulam-desmethyl					28	0	0						81	0	0										
TSA									106	1	0	0.06	69	0	0		35	0	0		33	0	0		
<b>Fluazifop-P-butyl</b>																	128	0	0						
Fluazifop-P	63	0	0		51	0	0		171	0	0						161	11	3	3.8					
TFMP									132	53	23	0.64					93	0	0						
<b>Fludioxonil</b>																									
CGA 192155	65	0	0		34	0	0																		
CGA 339833	65	0	0		34	0	0																		
<b>Fluopyram</b>					10	0	0		32	17	1	0.21					30	0	0		23	2	0	0.03	
Fluopyram-7-hydroxy					10	0	0		7	2	0	0.01					21	0	0		15	0	0		
<b>Flupyr-sulfuron-methyl</b>					30	0	0										36	0	0						
IN-JV460					30	0	0										36	0	0						
IN-KC576					30	0	0										36	0	0						
IN-KF311					32	0	0		69	0	0														
IN-KY374					30	4	3	0.45									36	0	0						
<b>Fluroxypyr</b>	68	0	0		55	0	0		50	0	0		90	3	2	1.4	256	1	1	0.19					
Fluroxypyr-methoxypyridine																	29	0	0						
Fluroxypyr-pyridinol																	29	0	0						
<b>Foramsulfuron</b>									75	10	2	0.24	92	20	3	0.32									
AE-F092944					2	0	0		75	0	0		92	1	0	0.01									
AE-F130619									75	10	0	0.07	92	6	0	0.06									
<b>Glyphosate</b>					69	0	0		257	108	22	4.7	601	343	109	31	237	5	0	0.09	33	21	8	8.6	
AMPA					69	1	0	0.01	258	203	18	0.35	601	499	120	1.6	237	15	1	0.11	33	26	5	1.3	
<b>Halauxifen-methyl</b>																									
X-729													61	0	0		1	0	0		25	0	0		
X-757									53	0	0						34	0	0						
<b>Iodosulfuron-methyl</b>									60	0	0														
Metsulfuron-methyl									60	0	0		154	1	0	0.05									
<b>Ioxynil</b>	72	0	0		61	0	0		48	0	0		142	20	5	0.25	173	1	0	0.01					
<b>Linuron</b>	67	0	0																						
<b>Mancozeb</b>																									
EBIS	27	0	0		10	0	0																		
ETU	44	7	0	0.04																					
<b>MCPA</b>					56	0	0		51	0	0		103	12	2	3.89	144	2	1	0.28					
2-methyl-4-chlorophenol					56	0	0		51	0	0		103	1	0	0.05	144	1	1	0.24					

Analyte	Tylstrup				Jyndeved				Silstrup				Estrup				Faardrup				Lund					
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L		
<b>Mesosulfuron-methyl</b>					78	0	0						75	13	0	0.06										
AE-F099095	54	0	0		43	0	0		51	0	0		48	0	0											
AE-F147447					47	0	0		51	0	0		20	0	0											
AE-F160459	54	0	0		43	0	0		51	0	0		48	0	0											
Mesosulfuron					45	0	0						74	0	0											
<b>Mesotrione</b>					67	0	0		76	13	7	1.1	93	40	10	3.3										
AMBA					67	0	0		76	0	0		93	4	0	0.04										
MNBA					67	0	0		76	8	0	0.09	93	11	1	0.46										
<b>Metalaxyl-M</b>	156	4	0	0.03	95	11	0	0.04																		
CGA 108906	153	128	35	4.8	105	68	34	3.7																		
CGA 62826	154	35	5	0.12	105	73	20	1.2																		
<b>Metamitron</b>									200	49	11	0.55	123	42	15	26.37	228	12	2	1.7						
Desamino-metamitron									201	64	7	0.67	125	49	11	5.55	228	16	4	2.5						
MTM-126-AMT																	33	0	0							
<b>Metconazole</b>													61	1	0	0.01										
<b>Metrafenone</b>													120	20	0	0.07	60	0	0							
<b>Metribuzin</b>	91	2	0	0.02	6	0	0																			
Desamino-diketo-metribuzin	247	81	51	2.1	6	0	0																			
Desamino-metribuzin	85	0	0		4	0	0																			
Diketo-metribuzin	318	253	61	0.69	6	3	0	0.09																		
<b>Pendimethalin</b>	144	0	0		71	0	0		105	14	0	0.06	130	4	0	0.04	57	2	0	0.04						
<b>Phenmedipham</b>									160	0	0						128	0	0							
3-aminophenol									89	0	0															
MHPC									155	0	0						128	2	1	0.19						
<b>Picloram</b>									1	0	0						1	0	0				26	1	0	0.01
<b>Picolinafen</b>					36	1	0	0.02					81	17	0	0.07										
CL153815					36	0	0						81	31	11	0.5										
<b>Pirimicarb</b>	82	0	0		69	0	0		233	14	0	0.05	205	40	0	0.08	228	7	0	0.06						
Pirimicarb-desmethyl	81	0	0		69	1	0	0.01	233	1	0	0.05	198	0	0		129	6	0	0.05						
Pirimicarb-desmethyl-formamido	52	0	0		69	0	0		161	0	0		230	26	13	0.38	129	3	0	0.04						
<b>Propaquizafop</b>									73	0	0															
CGA287422									73	0	0															
CGA290291									73	0	0															
CGA294972									73	0	0															
PPA									74	0	0															
<b>Propiconazole</b>	89	0	0		87	0	0		109	6	0	0.03	241	26	3	0.86	251	0	0							
<b>Propyzamide</b>	82	0	0						126	38	12	5.1	5	0	0		161	9	4	7		25	9	3	0.41	
RH-24580	82	0	0						66	2	0	0.02					125	0	0			25	0	0		
RH-24644	82	0	0						66	15	0	0.05					125	4	0	0.02		25	2	1	0.11	
RH-24655	58	0	0						66	0	0						124	1	0	0.02						
<b>Proquinazid</b>																										
IN-MM671					48	0	0		1	0	0						45	0	0							
IN-MM991					48	0	0		1	0	0						45	0	0							
<b>Prosulfocarb</b>	74	1	0	0.03					74	5	1	0.18					79	0	0							

Analyte	Tylstrup				Jyndeved				Silstrup				Estrup				Faardrup				Lund				
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	
<b>Pyridate</b>																									
PHCP					39	0	0																		
					59	0	0					66	4	4	2.69										
<b>Pyroxsulam</b>																									
5-OH-pyroxsulam												51	0	0											
6-Cl-7-OH-pyroxsulam												51	0	0											
7-OH-pyroxsulam												51	0	0											
PSA												51	0	0											
Pyridine sulfonamide												51	0	0											
<b>Rimsulfuron</b>																									
PPU	65	0	0		52	0	0																		
PPU-desamino	268	194	3	0.15	233	194	64	0.29	1	0	0														
	268	63	0	0.04	233	123	6	0.18	1	0	0														
<b>Tebuconazole</b>																									
1,2,4-triazole <sup>1</sup>	77	0	0		58	0	0		19	2	0	0.08	81	41	17	2	54	4	0	0.05					
	98	20	2	0.16	173	91	9	0.27	132	128	6	0.17	258	257	243	0.47	142	138	6	0.2	58	55	0	0.06	
<b>Terbuthylazine</b>																									
2-hydroxy-desethyl-terbuthylazine	72	0	0		79	0	0		91	60	9	1.55	161	112	34	11	111	41	11	10					
Desethyl-terbuthylazine	72	5	0	0.02					71	28	1	0.11	131	87	24	6.3	69	8	1	1					
Desisopropylatrazine	72	2	0	0.01	150	20	0	0.06	116	108	44	1.08	164	146	35	8.2	111	89	7	8.3					
Hydroxy-terbuthylazine	72	17	0	0.04					71	43	0	0.04	161	71	1	0.44	111	25	1	0.36					
	72	1	0	0.04					71	26	0	0.04	131	88	16	0.99	111	21	1	0.58					
<b>Thiacloprid</b>																									
M34													47	0	0										
Thiacloprid-amide													55	0	0										
Thiacloprid sulfonic acid													47	1	0	0.01									
													56	0	0										
<b>Thiamethoxam</b>																									
CGA 322704	64	0	0														68	0	0						
	64	0	0														68	0	0						
<b>Thiencarbazone-methyl</b>																									
AE1394083																	35	0	0						
<b>Thifensulfuron-methyl</b>																									
IN-B5528					10	0	0		7	0	0		41	0	0		21	0	0		15	0	0		
IN-JZ789													41	0	0										
IN-L9223													41	0	0										
<b>Thiophanate-methyl</b>																									
Carbendazim					60	0	0						63	3	0	0.02									
<b>Triasulfuron</b>																									
Triazinamin <sup>11</sup>	82	0	0																						
	75	0	0						88	0	0		206	0	0										
<b>Tribenuron-methyl</b>																									
IN-R9805					10	0	0		7	0	0						21	0	0		15	0	0		
M2					10	0	0		7	0	0						21	0	0		15	0	0		
Triazinamin-methyl	137	0	0		77	0	0		109	0	0		54	2	0	0.04	77	0	0						
<b>Triflusulfuron-methyl</b>																									
IN-D8526									32	0	0						63	0	0						
IN-E7710									32	0	0						63	0	0						
IN-M7222									32	5	0	0.01					63	0	0						
									32	0	0						63	0	0						

<sup>1</sup> Can include 1,2,4-triazole degraded from the pesticides: epoxiconazole, propiconazole, prothioconazole and metconazole (and difenoconazole applied as seed dressing).

<sup>11</sup> Can include triazinamin/IN-A4098 degraded from iodosulfuron-methyl, metsulfuron-methyl, tribenuron-methyl, triflusulfuron-methyl.

Table 8.2. Monitoring results from 1999 to 2022 from groundwater (1.5-9 mbgs). Total number of analysed samples (n), number of samples with detections (Det.), number of samples with detections in concentrations > 0.1 µg/L and the maximum detected concentration (Max µg/L). The pesticides and degradation products are listed under Analyte. All listed pesticides are applied in PLAP, but for some, only monitoring of the degradation product(s) was included in the programme. Analytes that are included in PLAP monitoring for the first time are written in red.

Analyte	Tylstrup				Jyndeved				Silstrup				Estrup				Faardrup				Lund			
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L
<b>Acetamiprid</b>																								
IM-1-4					211	0	0																	
IM-1-5					211	0	0																	
<b>Aclonifen</b>	127	0	0		171	0	0																	
<b>Amidosulfuron</b>					88	0	0						144	0	0									
Desmethyl-amidosulfuron					88	0	0																	
<b>Aminopyralid</b>	212	2	0	0.06									152	0	0									
<b>Azoxystrobin</b>	216	0	0		233	0	0		644	8	0	0.03	766	3	0	0.04	286	0	0		240	0	0	
CyPM	216	0	0		233	0	0		911	136	15	0.52	766	41	5	0.46	286	0	0		240	11	0	0.06
<b>Bentazone</b>	510	0	0		902	3	0	0.03	406	29	3	0.44	745	44	0	0.05	527	21	4	0.6	240	5	0	0.06
2-amino-N-isopropyl-benzamide	191	0	0		178	0	0		205	0	0		352	1	0	0.03	193	0	0					
6-hydroxy-bentazone	180	0	0		229	0	0														146	0	0	
8-hydroxy-bentazone	180	0	0		229	0	0														146	0	0	
N-methyl-bentazone	180	0	0		229	0	0														146	0	0	
<b>Bifenox</b>	49	0	0		222	2	0	0.05	183	5	0	0.1	192	0	0		104	0	0					
Bifenox acid	49	0	0		170	0	0		182	27	20	3.1	197	1	1	0.11	104	1	1	0.19				
Nitrofen	49	0	0		222	0	0		183	0	0		192	0	0		104	0	0					
<b>Boscalid</b>	111	0	0																					
<b>Bromoxynil</b>	192	0	0		218	0	0		159	0	0		167	1	0	0.01	306	0	0					
<b>Chlormequat</b>					14	0	0		102	0	0		74	0	0									
<b>Clomazone</b>	224	0	0		104	0	0		49	0	0		98	0	0		235	0	0					
FMC 65317	208	0	0		105	0	0		49	0	0		98	0	0		235	0	0					
<b>Clopyralid</b>	132	0	0						286	1	0	0.03					96	0	0					
<b>Cyazofamid</b>	127	0	0		135	0	0																	
CCIM					211	0	0																	
CTCA					211	0	0																	
DMSA					211	60	38	0.78																
N,N-DMS					211	80	43	0.44																
<b>Cycloxydim</b>																								
BH 517-T2SO2					207	0	0		154	0	0													
EZ-BH 517-TSO					200	2	0	0.03	154	37	0	0.05												
<b>Desmedipham</b>									348	1	0	0.03					231	0	0					
EHPC									180	0	0						175	0	0					
<b>Diffenican</b>					152	0	0		201	1	1	0.47	71	0	0									
AE-0542291					152	0	0		201	0	0		71	0	0									
AE-B107137					152	0	0		201	1	0	0.02	89	2	0	0.03								
<b>Dimethoate</b>	176	0	0		190	0	0		222	1	0	0.09	200	0	0		206	0	0					
<b>Epoxiconazole</b>	199	0	0		324	1	0	0.01	179	0	0		88	0	0		209	0	0					
<b>Ethofumesate</b>									529	5	0	0.04	205	0	0		361	31	6	1.4				

Analyte	Tylstrup				Jyndeved				Silstrup				Estrup				Faardrup				Lund			
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L
<b>Fenpropimorph</b>	307	0	0		254	1	0	0.03	222	0	0		189	0	0		306	1	0	0.02				
Fenpropimorph acid	276	0	0		260	0	0		221	0	0		158	0	0		306	0	0					
<b>Flamprop-M-isopropyl</b>	176	0	0						222	1	0	0.02	263	0	0		198	0	0					
Flamprop	176	0	0						222	0	0		263	0	0		206	0	0					
<b>Florasulam</b>					191	0	0						160	0	0									
5-OH-florasulam									142	0	0		118	0	0									
DFP-ASTCA									142	0	0		118	0	0									
DFP-TSA									142	0	0		118	0	0									
Florasulam-desmethyl													130	0	0									
TSA									306	0	0		118	0	0		141	0	0		220	0	0	
<b>Fluazifop-P-butyl</b>																231	0	0						
Fluazifop-P	178	0	0		190	0	0		440	1	0	0.07				298	6	1	0.17					
TFMP	3	0	0		3	0	0		435	87	16	0.29				238	0	0						
<b>Fludioxonil</b>																								
CGA 192155	182	0	0		232	1	0	0.05																
CGA 339833	182	0	0		221	1	1	0.37																
<b>Fluopyram</b>					41	0	0		92	4	0	0.02				67	0	0		84	0	0		
Fluopyram-7-hydroxy					41	0	0		33	0	0					34	0	0		29	0	0		
<b>Flupyr-sulfuron-methyl</b>					229	0	0									174	0	0						
IN-JV460					229	0	0									174	0	0						
IN-KC576					229	0	0									174	0	0						
IN-KF311					157	0	0		144	0	0		4	0	0									
IN-KY374					229	0	0									174	0	0						
<b>Fluroxypyr</b>	194	0	0		193	0	0		216	0	0		155	1	0	0.06	515	1	0	0.07				
Fluroxypyr-methoxypyridine																	146	0	0					
Fluroxypyr-pyridinol																	146	0	0					
<b>Foramsulfuron</b>									215	5	0	0.04	153	0	0									
AE-F092944									220	0	0		153	0	0									
AE-F130619					7	0	0		215	9	0	0.03	153	0	0									
<b>Glyphosate</b>					223	0	0		647	40	0	0.05	1016	53	6	0.67	451	5	0	0.03	219	2	0	0.02
AMPA					223	2	0	0.02	647	40	0	0.08	1018	8	0	0.07	451	2	0	0.03	218	4	0	0.02
<b>Halauxifen-methyl</b>													109	0	0		4	0	0		124	0	0	
X-729																	136	0	0					
X-757									150	0	0													
<b>Iodosulfuron-methyl</b>									250	0	0													
Metsulfuron-methyl									250	0	0		263	0	0									
<b>Ioxynil</b>	198	0	0		218	0	0		159	0	0		167	0	0		306	1	0	0.01				
<b>Linuron</b>	270	0	0																					
<b>Mancozeb</b>																								
EBIS	78	0	0		99	0	0																	
ETU	200	2	0	0.02																				
<b>MCPA</b>					210	0	0		190	0	0		147	1	0	0.02	364	0	0					
2-methyl-4-chlorophenol					210	0	0		191	0	0		147	0	0		363	0	0					

Analyte	Tylstrup				Jyndeved				Silstrup				Estrup				Faardrup				Lund							
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L				
<b>Mesosulfuron-methyl</b>					285	0	0						126	0	0													
AE-F099095	144	0	0		196	0	0		131	0	0		87	0	0													
AE-F147447					196	2	0	0.04	124	0	0		35	0	0													
AE-F160459	144	0	0		189	0	0		131	0	0		87	0	0													
Mesosulfuron					12	0	0						107	0	0													
<b>Mesotrione</b>					237	0	0		223	0	0		157	5	1	0.13												
AMBA					237	0	0		223	0	0		157	0	0													
MNBA					237	0	0		223	0	0		155	1	0	0.02												
<b>Metalaxyl-M</b>	352	21	0	0.08	392	88	23	1.3																				
CGA 108906	352	288	47	1.5	393	278	84	2.7																				
CGA 62826	352	17	0	0.04	393	174	9	0.68																				
<b>Metamitron</b>									529	29	2	0.17	205	0	0		473	24	4	0.63								
Desamino-metamitron									529	30	4	0.19	204	0	0		473	48	12	1.3								
MTM-126-AMT																	108	0	0									
<b>Metconazole</b>													109	0	0													
<b>Metrafenone</b>													188	1	0	0.04	168	0	0									
<b>Metribuzin</b>	387	1	0	0.01	26	0	0																					
Desamino-diketo-metribuzin	525	236	5	0.2	26	20	13	1.83																				
Desamino-metribuzin	365	0	0		26	0	0																					
Diketo-metribuzin	512	453	315	0.55	26	26	19	1.37																				
<b>Pendimethalin</b>	430	0	0		257	0	0		344	0	0		188	0	0		180	0	0									
<b>Phenmedipham</b>									348	0	0						231	2	0	0.03								
3-aminophenol									240	0	0						231	1	0	0.05								
MHPC									340	0	0						231	1	0	0.05								
<b>Picloram</b>																	4	0	0		136	1	0	0.05				
<b>Picolinafen</b>					35	0	0						158	0	0													
CL153815					35	0	0						158	0	0													
<b>Pirimicarb</b>	295	0	0		251	0	0		646	3	0	0.01	294	1	0	0.02	436	2	0	0.04								
Pirimicarb-desmethyl	295	0	0		251	0	0		646	0	0		290	0	0		231	3	0	0.04								
Pirimicarb-desmethyl-formamido	167	0	0		251	0	0		468	0	0		338	0	0		231	2	0	0.08								
<b>Propaquizafop</b>																												
CGA287422									193	0	0																	
CGA290291									193	0	0																	
CGA294972									193	0	0																	
PPA									193	0	0																	
<b>Propiconazole</b>	307	0	0		287	0	0		222	0	0		398	2	0	0.02	510	1	0	0.04								
<b>Propyzamide</b>	221	0	0						396	27	6	0.22	7	0	0		450	2	0	0.07	124	2	0	0.02				
RH-24580	221	0	0						227	0	0						364	0	0		124	0	0					
RH-24644	221	0	0						227	2	0	0.03					364	0	0		124	0	0					
RH-24655	157	0	0						227	0	0						360	0	0									
<b>Proquinazid</b>																												
IN-MM671					187	0	0										107	0	0									
IN-MM991					187	0	0										107	0	0									

Analyte	Tylstrup				Jyndeved				Silstrup				Estrup				Faardrup				Lund			
	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L	n	Det.	>0.1 µg/L	Max µg/L
<b>Prosulfocarb</b>	168	4	0	0.03					226	1	0	0.03					187	0	0					
<b>Pyridate</b>					116	0	0																	
PHCP					184	0	0		189	14	4	0.31												
<b>Pyroxsulam</b>																								
5-OH-pyroxsulam									142	0	0		118	0	0									
6-Cl-7-OH-pyroxsulam									142	0	0		118	0	0									
7-OH-pyroxsulam									142	0	0		118	0	0									
PSA									142	0	0		118	0	0									
Pyridine sulfonamide									142	0	0		118	0	0									
<b>Rimsulfuron</b>	178	0	0		189	0	0																	
PPU	656	58	0	0.05	863	374	12	0.23																
PPU-desamino	656	9	0	0.03	863	98	0	0.09																
<b>Tebuconazole</b>	196	1	0	0.01	214	1	0	0.01	38	0	0		162	5	2	0.12	174	1	0	0.01				
1,2,4-triazole <sup>1</sup>	266	111	0	0.06	799	485	6	0.18	369	155	4	0.2	429	387	79	0.26	503	37	0	0.04	318	229	2	0.12
<b>Terbuthylazine</b>	179	0	0		260	0	0		316	36	1	0.12	286	1	0	0.02	283	51	21	1.9				
2-hydroxy-desethyl-terbuthylazine	191	1	0	0.03					236	1	0	0.02	230	0	0		193	7	0	0.09				
Desethyl-terbuthylazine	191	0	0		517	27	0	0.02	375	161	2	0.14	298	7	0	0.05	283	66	30	0.94				
Desisopropylatrazine	191	1	0	0.01					236	4	0	0.05	286	27	0	0.03	283	60	0	0.04				
Hydroxy-terbuthylazine	191	0	0						236	0	0		230	0	0		283	34	0	0.07				
<b>Thiacloprid</b>													100	0	0									
M34													100	0	0									
Thiacloprid-amide													100	0	0									
Thiacloprid sulfonic acid													100	0	0									
<b>Thiamethoxam</b>	175	0	0														184	0	0					
CGA 322704	175	0	0														184	0	0					
<b>Thiencarbazon-methyl</b>																	111	0	0					
AE1394083																	111	0	0					
<b>Thifensulfuron-methyl</b>																								
IN-B5528					41	0	0		33	0	0		79	0	0		34	0	0		29	0	0	
IN-JZ789													79	0	0									
IN-L9223													79	0	0									
<b>Thiophanate-methyl</b>																								
Carbendazim					238	0	0						105	0	0									
<b>Triasulfuron</b>	295	0	0																					
Triazinamin <sup>II</sup>	285	0	0						341	0	0		345	1	0	0.04								
<b>Tribenuron-methyl</b>																								
IN-R9805					41	0	0		33	0	0						34	0	0		29	0	0	
M2					41	0	0		33	0	0						34	0	0		29	0	0	
Triazinamin-methyl	440	0	0		248	0	0		222	0	0		104	0	0		204	0	0					
<b>Triflusulfuron-methyl</b>									158	0	0						130	0	0					
IN-D8526									158	0	0						130	0	0					
IN-E7710									158	0	0						130	0	0					
IN-M7222									158	1	0	0.05					130	0	0					

<sup>1</sup> Can include 1,2,4-triazole degraded from the pesticides: epoxiconazole, propiconazole, prothioconazole and metconazole (and difenoconazole applied as seed dressing).

<sup>II</sup> Can include triazinamin/IN-A4098 degraded from iodosulfuron-methyl, metsulfuron-methyl, tribenuron-methyl, triflusulfuron-methyl.

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## 10. Appendixes

### **Appendix 1**

Pesticides and degradation products included in PLAP

### **Appendix 2**

Sampling programme and drainage

### **Appendix 3**

Agricultural management

### **Appendix 4**

Precipitation at the PLAP fields

### **Appendix 5**

Pesticide detections in samples from drains, suction cups and groundwater screens

### **Appendix 6**

QC charts for internal quality control

### **Appendix 7**

Pesticides analysed at five PLAP fields in the period up to 2020

### **Appendix 8**

Horizontal wells

### **Appendix 9**

Groundwater age from recharge modelling and tritium-helium analysis

## **Appendix 1**

### **Pesticides and degradation products included in PLAP**

**Table A1.1.** EFSA nomenclature (pesticide and analyte), systematic chemical nomenclature, CAS no. for the pesticides and degradation products included in PLAP. P: parent, M: degradation product; Analyte: compound included in the monitoring; N: Total number of samples analysed in PLAP including QC samples. Monitoring is ongoing if the latest analysis date is in June 2022.

Pesticide	P/M	Analyte	CAS no.	Systematic name	Latest analysis	N
Acetamiprid	P	Acetamiprid	135410-20-7	N-[(6-chloropyridin-3-yl)methyl]-N'-cyano-N-methylethanimidamide	17-07-2020	2
Acetamiprid	M	IM-1-4	120739-62-0	1-(6-Chloro-3-pyridyl)-N-methylmethanamine; N-methyl(6-chloro-3-pyridyl)methylamine	07-06-2022	297
Acetamiprid	M	IM-1-5		N-(6-chloropyridin-3-ylmethyl)-N-methyl-acetamidine	07-06-2022	297
Aclonifen	P	Aclonifen	74070-46-5	2-chloro-6-nitro-3-phenoxyaniline	18-06-2013	471
Amidosulfuron	P	Amidosulfuron	120923-37-7	N-[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-amino]sulfonyl]-N-methylmethanesulfonamide	01-03-2006	562
Amidosulfuron	M	desmethyl-amidosulfuron	935867-69-9	3-(4-hydroxy-6-methoxypyrimidin-2-yl)-1-(N-methyl-N-methylsulfonyl-aminosulfonyl)-urea	01-03-2006	129
Aminopyralid	P	Aminopyralid	150114-71-9	4-amino-3,6-dichloropyridine-2-carboxylic acid	08-04-2015	619
Amitrol	P	Amitrol **	61-82-5	1H-1,2,4-triazol-5-amine	16-09-2020	62
Azoxystrobin	P	Azoxystrobin	131860-33-8	Methyl (E)-2-{2-[(6-(2-cyanophenoxy)-4-pyrimidin-4-yloxy)phenyl]-3-methoxyacrylate	16-06-2020	3715
Azoxystrobin	M	CyPM	1185255-09-7	E-2-(2-[6-cyanophenoxy]-pyrimidin-4-yloxy)-phenyl)-3-methoxyacrylic acid	29-06-2022	4091
Bentazone	P	Bentazone	25057-89-0	3-(1-methylethyl)-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2 dioxide	27-03-2019	5480
Bentazone	M	N-methyl-bentazone	61592-45-8	3-methyl-2,2-dioxo-1H-2,1,3-benzothiadiazin-4-one	25-04-2018	736
Bentazone	M	8-hydroxy-bentazone	60374-43-8	8-Hydroxy-3-(1-methylethyl)-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-Dioxide	25-04-2018	734
Bentazone	M	2-amino-N-isopropyl-benzamide	30391-89-0	2-amino-N-isopropylbenzamide	28-06-2007	2142
Bentazone	M	6-hydroxy-bentazone	60374-42-7	6-Hydroxy-3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide	25-04-2018	736
Bifenox	P	Bifenox	42576-02-3	methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate	27-12-2012	1191
Bifenox	M	Bifenox acid	53774-07-5	5-(2,4-dichlorophenoxy)-2-nitrobenzoic acid	27-12-2012	1109
Bifenox	M	Nitrofen	1836-75-5	2,4-dichlorophenyl 4'-nitrophenyl ether	27-12-2012	1191
Boscalid	P	Boscalid	188425-85-6	2-chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide	11-12-2012	190
Bromoxynil	P	Bromoxynil	1689-84-5	3,5-dibromo-4-hydroxybenzoxynitrile	31-03-2015	1990
Chlormequat	P	Chlormequat	7003-89-6	2-chloroethyltrimethylammonium	10-07-2008	335
Clomazone	P	Clomazone	81777-89-1	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidione	08-04-2015	1118
Clomazone	M	FMC 65317	171569-37-2	(N-[2-chlorophenyl)methyl]-3-hydroxy-2,2-dimethylpropanamide (Propanamide-clomazone)	08-04-2015	1090
Clopyralid	P	Clopyralid	1702-17-6	3,6-Dichloropyridine-2-carboxylic acid	12-03-2009	831
Cyazofamid	P	Cyazofamid	120116-88-3	4-chloro-2-cyano-N,N-dimethyl-5-(4-methylphenyl)imidazole-1-sulfonamide	10-09-2020	423
Cyazofamid	M	CCIM	120118-14-1	Cyazofamid-dessulfonamide, 4-chloro-5-(4-methylphenyl)-1H-imidazole-2-carbonitrile	07-06-2022	297
Cyazofamid	M	DMSA	6623-40-1	dimethylsulfamic acid; n,n-dimethylsulfamic acid	07-06-2022	297
Cyazofamid	M	CTCA	1287189-46-1	4-chloro-5-(4-methylphenyl)-1H-imidazole-2-carboxylic acid	07-06-2022	297
Cyazofamid	M	N,N-DMS	3984-14-3	N,N-dimethylsulfamide	07-06-2022	297
Cycloxydim	M	EZ-BH 517-TSO	119759-56-7	2-[1-(ethylimino)butyl]-3-hydroxy-5-(tetrahydro-2H-thiopyran-3-yl)-2-cyclohexen-1-one S-oxide	28-10-2020	486

Cycloxydim	M	BH 517-T2SO2	119725-80-3	2-propyl-6-(3-thianyl)-4,5,6,7-tetrahydrobenzoxazol-4-one S-dioxide	28-10-2020	493
Desmedipham	P	Desmedipham	13684-56-5	Ethyl 3-(phenylcarbamoyloxy)phenylcarbamate	24-06-2003	972
Desmedipham	M	EHPC	7159-96-8	Carbamic acid, (3-hydroxyphenyl)-ethyl ester	24-06-2003	608
Diflufenican	P	Diflufenican	83164-33-4	2',4'-difluoro-2-(?,?,?-trifluoro-m-tolyloxy)nicotinilide	08-04-2015	662
Diflufenican	M	AE-0542291	-	2-[3-(trifluoromethyl)phenoxy]pyridine-3-carboxamide	08-04-2015	662
Diflufenican	M	AE-B107137	36701-89-0	2-[3-(trifluoromethyl)phenoxy]pyridine-3-carboxylic acid	08-04-2015	690
Dimethoate	P	Dimethoate	60-51-5	O,O-dimethyl S-methylcarbamoylmethyl-phosphorodithioate	13-06-2005	2033
Epoxiconazole	P	Epoxiconazole	106325-08-0	(2RS, 3SR)-1-(2-(2-chlorophenyl)-2,3-epoxy-2-(4-fluorophenyl)propyl)-1H-1,2,4-triazol	02-12-2009	1527
Ethofumesate	P	Ethofumesate	26225-79-6	(±)-2-ethoxy-2,3-dihydro-3,3-dimethylbenzofuran-5-yl-methanesulfonate	30-06-2011	1827
Fenpropimorph	P	Fenpropimorph	67564-91-4	Cis-4-[3-[4-(1,1-dimethylethyl)-phenyl]-2-methylpropyl]-2,6-imethylmorpholine	17-06-2003	2478
Fenpropimorph	M	Fenpropimorph acid	121098-45-1	Cis-4-[3-[4-(2-carboxypropyl)-phenyl]-2-methylpropyl]-2,6-dimethylmorpholine	17-06-2003	2314
Flamprop-M-isopropyl	P	Flamprop-M-isopropyl	63782-90-1	Isopropyl N-benzoyl-N-(3-chloro-4-flourophenyl)-D-alaninate	13-06-2005	1983
Flamprop-M-isopropyl	M	Flamprop	58667-63-3	N-benzoyl-N-(3-chloro-4-flourophenyl)-D-alanine	13-06-2005	1987
Florasulam	P	Florasulam	145701-23-1	2',6',8-Trifluoro-5-methoxy-s-triazolo [1,5-c]pyrimidine-2-sulfonanilide	03-05-2020	581
Florasulam	M	5-OH-florasulam	292085-54-2	N-(2,6-difluorophenyl)-8-fluoro-5-oxo-5,6-dihydro[1,2,4]triazolo[1,5-c]pyrimidine-2-sulfonamide	16-03-2022	423
Florasulam	M	DFP-ASTCA	313963-92-7	3-[(2,6-difluorophenyl)sulfamoyl]-1H-1,2,4-triazole-5-carboxylic acid	16-03-2022	423
Florasulam	M	DFP-TSA	313963-94-9	N-(2,6-difluorophenyl)-1H-1,2,4-triazole-3-sulfonamide	16-03-2022	423
Florasulam	M	Florasulam-desmethyl	292085-54-2	N-(2,6-difluorophenyl)-8-fluro-5-hydroxy[1,2,4]triazolo[1,5-c]pyrimidine-2-sulfonamide	19-06-2008	275
Florasulam	M	TSA	89517-96-4	1H-1,2,4-triazole-3-sulfonamide	16-03-2022	1137
Fluazifop-P-butyl	P	Fluazifop-P-butyl	79241-46-6	butyl (R)-2-{4-[5-(trifluoromethyl)-2-pyridyloxy]phenoxy}propionate	24-06-2003	401
Fluazifop-P-butyl	M	Fluazifop-P	83066-88-0	(R)-2-{4-[(5-(trifluoromethyl)-2-pyridinyl)oxy]phenoxy}propanoic acid	28-03-2012	1759
Fluazifop-P-butyl	M	TFMP	33252-63-0	5-trifluoromethyl-pyridin-2-ol	08-04-2015	1012
Fludioxonil	M	CGA 192155	126120-85-2	2,2-difluoro-benzo[1,3]dioxol-4-carbocyclic acid	05-04-2016	569
Fludioxonil	M	CGA 339833	-	3-carbamoyl-2-cyano-3-(2,2-difluoro-1,3-benzodioxol-4-yl)oxirane-2-carboxylic acid	05-04-2016	558
Fluopyram	P	Fluopyram	658066-35-4	N-[2-[3-chloro-5-(trifluoromethyl)pyridin-2-yl]ethyl]-2-(trifluoromethyl)benzamide	29-06-2022	430
Fluopyram	M	Fluopyram-7-hydroxy	856699-69-9	N-{2-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]-2-hydroxyethyl}-2-(trifluoromethyl)benzamide; M08	29-06-2022	217
Flupyrulfuron-methyl	P	Flupyrulfuron-methyl	144740-54-5	Methyl 2-[[[(4,6-dimethoxy-2-pirimidinyl)amino]carbonyl]-amino]sulfonyl]-6-(trifluoromethyl)-3-pyridinecarboxylate sodium salt	08-05-2018	513

Flupyrulfuron-methyl	M	IN-KY374		N-(4,6-dimethoxyimidin-2-yl)-N-(3-methoxycarbonyl-6-trifluoromethylpyridin-2-yl)-amine	11-10-2016	512
Flupyrulfuron-methyl	M	IN-JV460		1-(4,6-dimethoxyimidin-2-yl)-2,4-diketo-7-trifluoromethyl-1,2,3,4-tetrahydropyridol(2,3-d)imidin	11-10-2016	512
Flupyrulfuron-methyl	M	IN-KC576		4-(4-methoxy-6-oxo-1H-pyrimidin-2-yl)-7-(trifluoromethyl)-4H-2,6-naphthyridin-1,3-dione	11-10-2016	512
Flupyrulfuron-methyl	M	IN-KF311	223660-64-8	1-(4,6-dihydroxyimidin-2-yl)-7-(trifluoromethyl)pyrido[2,3-d]imidin-2,4(1H,3H)-dione	25-03-2020	444
Fluroxypyr	P	Fluroxypyr	69377-81-7	(4-amino-3,5-dichloro-6-fluro-2-pyridinyl)oxy]acetic acid	12-06-2008	2044
Fluroxypyr	M	Fluroxypyr-methoxyimidin	35622-80-1	4-amino-3,5-dichloro-6-fluro-2-pyridinyl-2-methoxyimidin	08-05-2018	192
Fluroxypyr	M	Fluroxypyr-pyridinol	94133-62-7	4-amino-3,5-dichloro-6-fluro-2-pyridinol	08-05-2018	192
Foramsulfuron	P	Foramsulfuron	173159-57-4		08-05-2018	594
Foramsulfuron	M	AE-F130619	190520-75-3	4-amino-2-[3-(4,6-dimethoxyimidin-2-yl)ureidosulfonyl]-N, N-dimethylbenzamide	08-05-2018	594
Foramsulfuron	M	AE-F092944	36315-01-2	2-amino-4,6-dimethoxyimidin	07-05-2019	610
Glyphosate	P	Glyphosate	1071-83-6	N-(phosphonomethyl)glycine	11-09-2019	4458
Glyphosate	M	AMPA	1066-51-9	Amino-methylphosphonic acid	11-09-2019	4457
Halauxifen-methyl	P	Halauxifen-methyl	943831-98-9	methyl 4-amino-3-chloro-6-(4-chloro-2-fluro-3-methoxyphenyl)pyridin-2-carboxylate	17-12-2020	3
Halauxifen-methyl	M	X-757		4-amino-3-chloro-6-(4-chloro-2-fluro-3-hydroxyphenyl)pyridin-2-carboxylic acid	25-09-2019	409
Halauxifen-methyl	M	X-729	943832-60-8	4-amino-3-chloro-6-(4-chloro-2-fluro-3-methoxyphenyl)pyridin-2-carboxylic acid (halauxifen)	30-03-2021	365
Iodosulfuron-methyl	P	Iodosulfuron-methyl	144550-36-7	sodium salt of methyl 4-iodo-2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoate	22-12-2010	355
Iodosulfuron-methyl	M	Metsulfuron-methyl	74223-64-6	methyl 2-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)carbamoylsulfamoyl]benzoate	22-12-2010	1345
loxynil	P	loxynil	1689-83-4	4-hydroxy-3,5-diiodobenzonitrile	31-03-2015	1996
Linuron	P	Linuron	330-55-2	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	13-09-2001	388
ancozeb	M	ETU	96-45-7	Ethylenethiourea	03-04-2001	278
Mancozeb	M	EBIS	33813-20-6	ethylene bisisothiocyanate sulfide	19-03-2015	238
MCPA	P	MCPA	94-74-6	(4-chloro-2-methylphenoxy)acetic acid	29-06-2006	1467
MCPA	M	2-methyl-4-chlorophenol	1570-64-5	2-methyl-4-chlorophenol	29-06-2006	1459
Mesosulfuron-methyl	P	Mesosulfuron-methyl	208465-21-8	Methyl 2-[3-(4,6-dimethoxyimidin-2-yl)ureidosulfonyl]-4-methanesulfonamidomethylbenzoate	19-04-2018	649
Mesosulfuron-methyl	M	AE-F147447	888225-62-5	N-[[1,1-Dioxido-3-oxo-2,3-dihydro-1,2-benzothiazol-6-yl)methyl]methanesulfonamide	25-03-2020	530
Mesosulfuron-methyl	M	AE-F160459		Methyl 2-[[4-methoxy-6-oxo-1,6-dihydroimidin-2-yl]carbamoyl]sulfamoyl]-4-[[methylsulfonyl]amino]methyl]benzoate	31-03-2020	830
Mesosulfuron-methyl	M	AE-F099095	151331-81-6	4,6-dimethoxyimidin-2-yl-urea	31-03-2020	837

Mesosulfuron-methyl	M	Mesosulfuron	400852-66-6	2-[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-4-[[[(methylsulfonyl)amino]methyl]benzoic acid	02-12-2009	270
Mesotrione	P	Mesotrione	104206-82-8	2-(4-mesyl-2-nitrobenzoyl)cyclohexane-1,3-dione	08-05-2018	949
Mesotrione	M	MNBA	110964-79-9	methylsulfonyl-2-nitrobenzoic acid	08-05-2018	947
Mesotrione	M	AMBA	393085-45-5	2-amino-4-methylsulfonylbenzoic acid	08-05-2018	949
Metalaxyl-M	P	metalaxyl-M	70630-17-0	methyl N-(methoxyacetyl)-N-(2,6-xylyl)-D-alaninate	19-03-2015	1117
Metalaxyl-M	M	CGA 62826	75596-99-5	2-[(2,6-dimethylphenyl)(methoxyacetyl)amino]propanoic acid	19-03-2015	1126
Metalaxyl-M	M	CGA 108906	104390-56-9	2-[(1-carboxyethyl)(methoxyacetyl)amino]-3-methylbenzoic acid	19-03-2015	1124
Metamitron	P	Metamitron	41394-05-2	4-amino-4,5-dihydro-3-methyl-6-phenyl-1,2,4-triazin-5-one	31-03-2020	1984
Metamitron	M	MTM-126-AMT	70569-26-5	4-amino-3-methyl-1,2,4-triazin-5-one	31-03-2020	154
Metamitron	M	Desamino-metamitron		4,5-dihydro-3-methyl-6-phenyl-1,2,4-triazine-5-one	31-03-2020	1980
Metconazole	P	Metconazole	125116-23-6	(1RS,5RS:1RS,5SR)-5-(4-chlorobenzyl)-2,2-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl) cyclopentanol	30-03-2021	193
Metrafenone	P	Metrafenone	220899-03-6	3'-bromo-2,3,4,6'-tetramethoxy-2',6'-dimethylbenzophenone	08-04-2015	608
Metribuzin	P	Metribuzin	21087-64-9	4-amino-6-tert-butyl-4,5-dihydro-3-methylthio-1,2,4-triazine-5-one	28-05-2002	576
Metribuzin	M	Desamino-metribuzin	35045-02-4	6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5-(4H)-one	28-05-2002	539
Metribuzin	M	Diketo-metribuzin	56507-37-0	4-amino-6-tert-butyl-4,5-dihydro-1,2,4-triazine-3,5-dione	09-03-2011	944
Metribuzin	M	Desamino-diketo-metribuzin	52236-30-3	6-tert-butyl-4,5-dihydro-3-methylthio-1,2,4-triazine-3,5-dione	09-04-2008	889
Pendimethalin	P	Pendimethalin	40487-42-1	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzamine	10-12-2009	2567
Phenmedipham	P	Phenmedipham	13684-63-4	3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate	24-06-2003	973
Phenmedipham	M	MHPC	13683-89-1	Methyl-N-(3-hydroxyphenyl)-carbamate	24-06-2003	952
Phenmedipham	M	3-aminophenol	591-27-5	1-amino-3-hydroxybenzene	26-02-2002	362
Picloram	P	Picloram	01-02-1918	4-Amino-3,5,6-trichloropyridine-2-carboxylic acid	22-12-2021	190
Picolinafen	P	Picolinafen	137641-05-5	4'-fluoro-6-(a,a,a-trifluoro-m-tolyloxy)pyridine-2-carboxanilide	30-03-2010	352
Picolinafen	M	CL153815	137640-84-7	6-(3-trifluoromethylphenoxy)-2-pyridine carboxylic acid	30-03-2010	352
Pirimicarb	P	Pirimicarb	23103-98-2	2-(dimethylamino)-5,6-dimethyl-4-pyrimidinyl dimethylcarbamate	26-06-2007	3425
Pirimicarb	M	Pirimicarb-desmethyl	30614-22-3	2-(dimethylamino)-5,6-dimethyl-4-pyrimidinyl methylcarbamate	26-06-2007	3069
Pirimicarb	M	Pirimicarb-desmethyl-formamido	27218-04-8	2-methylformamido-5,6-dimethylpyrimidine-4-yl dimethylcarbamate	26-06-2007	2673
Propaquizafop	P	propaquizafop	111479-05-1		09-04-2019	1
Propaquizafop	M	PPA	94050-90-5	(R)-2-(4-hydroxy-phenoxy)-propionic acid	29-12-2021	294
Propaquizafop	M	CGA 294972		2-[4-(6-chloro-3-hydroxy-quinoxalin-2-yloxy)-phenoxy]-propionic acid; hydroxy-quizalofop; 3-OH-quizalofop acid; Hydroxy Propaquizafop acid	29-12-2021	293

Propaquizafop	M	CGA290291	27925-27-5	6-chloro-3H-quinoxalin-2-one; 6-chloroquinoxalin-2-ol; hydroxy-quinoxaline	29-12-2021	293
Propaquizafop	M	CGA287422	76578-12-6	2-[4-(6-chloroquinoxalin-2-yl)oxyphenoxy]-propanoic acid (quizalofop; quizalofop acid; propaquizafop acid)	29-12-2021	293
Propiconazole	P	Propiconazole	60207-90-1	1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole	22-03-2005	3398
Propyzamide	P	Propyzamide	23950-58-5	3,5-dichloro-N-(1,1-dimethylprop-2-ynyl)benzamide	29-06-2022	1816
Propyzamide	M	RH-24580	29918-41-0	3,5-Dichloro-N-(2-methyl-3-oxobutan-2-yl)benzamide	08-09-2021	1407
Propyzamide	M	RH-24644	29918409	2-(3,5-dichlorophenyl)-4,4-dimethyl-5-methylene-oxazoline	08-09-2021	1407
Propyzamide	M	RH-24655		3,5-Dichloro-N-(2-methylbut-3-en-2-yl)benzamide	08-04-2015	1134
Proquinazid	P	Proquinazid	189278-12-4	6-iodo-2-propoxy-3-propylquinazolin-4(3H)-one	09-05-2019	2
Proquinazid	M	IN-MM671	213271-86-4	2-propoxy-3-propylquinazolin-4(3H)-one	24-03-2021	435
Proquinazid	M	IN-MM991	20297-19-2	3-propylquinazoline-2,4(1H,3H)-dione	24-03-2021	435
Prosulfocarb	P	Prosulfocarb	52888-80-9	N-[[3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-3-[2-(3,3,3-trifluoro=propyl)phenylsulfonyl]urea	19-03-2015	922
Prothioconazole	P	Prothioconazole	178928-70-6	(RS)-2-[2-(1-chlorocyclopropyl)-3-(2-chlorophenyl)-2-hydroxypropyl]-2,4-dihydro-1,2,4-triazole-3-thione	04-05-2022	8
Prothioconazole	M	Prothioconazole-desthio	120983-64-4	(2RS)-(1-chlorocyclopropyl)-1-(2-chlorophenyl)-3-(1H1,2,4-triazol-1-yl)-2-propanol	04-05-2022	4
Pyridate	P	Pyridate	55512-33-9	O-6-chloro-3-phenylpyridazin-4-yl S-octyl thiocarbonate	03-09-2002	183
Pyridate	M	PHCP	40020-01-7	3-phenyl-4-hydroxy-6-chloropyridazine	02-06-2004	571
Pyroxsulam	P	Pyroxsulam	422556-08-9	N-(5,7-dimethoxy-1,2,4)triazolo[1,5-a]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide	03-05-2020	2
Pyroxsulam	M	Pyridine sulfonamide	2757917-20-5	2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide	16-03-2022	423
Pyroxsulam	M	7-OH-pyroxsulam		7-OH-pyroxsulam; N-(7-hydroxy-5-methoxy[1,2,4]triazolo[1,5-a]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide	16-03-2022	423
Pyroxsulam	M	PSA		2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonic acid	16-03-2022	423
Pyroxsulam	M	5-OH-pyroxsulam		5-OH-pyroxsulam; N-(5-hydroxy-7-methoxy[1,2,4]triazolo[1,5-a]pyrimidin-2-yl)-2-methoxy-4-trifluoromethyl)-3-pyridinesulfonamide	16-03-2022	423
Pyroxsulam	M	6-Cl-7-OH-pyroxsulam		6-Cl-7-OH-pyroxsulam; N-(6-chloro-7-hydroxy-5-methoxy[1,2,4]triazolo[1,5-a]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)pyridine-3-sulfonamide	16-03-2022	423
Rimsulfuron	P	Rimsulfuron	122931-48-0	N-[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-3-(ethylsulfonyl)-2-pyridinesulfonamide	14-06-2006	561
Rimsulfuron	M	PPU	138724-53-5	N-(4,6-dimethoxy-2-pyrimidinyl-N-((3-ethylsulfonyl)-2-pyridinyl)urea (IN70941)	11-12-2012	2311
Rimsulfuron	M	PPU-desamino	151331-80-5	N-((3-(ethylsulfonyl)-2-pyridyl)-4,6 dimethoxy-2-pyrimidinamine (IN70942)	11-12-2012	2311
Tebuconazole	P	Tebuconazole	107534-96-3	a-[2-(4-chlorophenyl)ethyl]-a-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol	27-12-2012	1220
Tebuconazole	M	1,2,4-triazol	288-88-0	1,2,4-triazol	29-06-2022	3923
Terbuthylazine	P	Terbuthylazine	5915-41-3	6-chloro-N-(1,1-dimethylethyl)-N-ethyl-1,3,5, triazine-2,4-diamine	25-03-2009	2117
Terbuthylazine	M	Desisopropylatrazine	1007-28-9	6-chloro-N-ethyl-1,3,5-triazine-2,4-diamine	25-03-2009	1619
Terbuthylazine	M	Hydroxy-terbuthylazine	66753-07-9	6-hydroxy-N-(1,1-dimethylethyl)-N'-ethyl-1,3,5, triazine-2,4-diamine	19-06-2008	1521

Terbuthylazine	M	Desethyl- terbuthylazine	30125-63-4	6-chloro-N-(1,1-dimethylethyl)-1,3,5-triazine-2,4-diamine	10-06-2009	2620
Terbuthylazine	M	2-hydroxy-desethyl- terbuthylazine	66753-06-8	6-hydroxy-N-(1,1-dimethylethyl)-1,3,5-triazine-2,4-diamine	19-06-2008	1372
Thiacloprid	P	Thiacloprid	111988-49-9	(Z)-3-(6-chloro-3-pyridylmethyl)-1,3-thiazolidin-2-ylidenecyanamide	28-03-2012	168
Thiacloprid	M	M34		2-{carbamoyl[(6-chloropyridin-3-yl)methyl]amino}ethanesulfonic acid	28-03-2012	176
Thiacloprid	M	Thiacloprid sulfonic acid		sodium 2-[[[(aminocarbonyl)amino]-carbonyl][(6-chloro-3-pyridinyl)-methyl]amino]ethanesulfonate	28-03-2012	177
Thiacloprid	M	Thiacloprid-amide	676228-91-4	(3-[(6-chloro-3-pyridinyl)methyl]-2-thiazolidinylidene) urea	28-03-2012	168
Thiamethoxam	P	Thiamethoxam	153719-23-4	3-(2-chloro-thiazol-5-ylmethyl)-5-methyl[1,3,5]oxadiazinan-4ylidene-N-nitroamine	18-06-2008	559
Thiamethoxam	M	CGA 322704	210880-92-5	[C(E)]-N-[(2-chloro-5-thiazolyl)methyl]-N'-methyl-N'-nitroguanidine	18-06-2008	559
Thiencarbazone-methyl	M	AE1394083	936331-72-5	4-((4,5-Dihydro-3-methoxy-4-methyl-5-oxo-1H-1,2,4-triazol-1-yl)carbonylsulfamoyl)-5-methylthiophene-3-carboxylic acid (Thiencarbazone)	31-03-2020	159
Thifensulfuron-methyl	P	Thifensulfuron-methyl	79277-27-3	Methyl 3-(4-methoxy-6-methyl-1,3,5-triazin-2-ylcarbamoylsulfamoyl)thiophene-2-carboxylate	01-06-2021	1
Thifensulfuron-methyl	M	IN-JZ789	-	3-[[[(4-hydroxy-6-methyl-1,3,5-triazin-2-yl)carbamoyl]sulfamoyl]thiophene-2-carboxylic acid	29-06-2022	134
Thifensulfuron-methyl	M	IN-L9223	59337-97-2	3-sulfamoylthiophene-2-carboxylic acid; 2-acid-3-sulfonamide	29-06-2022	134
Thifensulfuron-methyl	M	IN-B5528	16352-06-0	4-amino-6-methyl-1,3,5-triazin-2-ol	29-06-2022	351
Thiophanate-methyl	M	Carbendazim	?10605-21-7	methyl benzimidazol-2-ylcarbamate	07-10-2020	525
Triasulfuron	P	Triasulfuron	82097-50-5	1-[2-(2-chloroethoxy)phenylsulfonyl]-2-(4-methoxy-6-methyl-1,3,5-triazine-2-yl)-urea	04-03-2003	439
Triasulfuron	M	Triazinamin *	1668-54-8	2-amino-4-methoxy-6-methyl-1,3,5-triazine	04-04-2018	2030
Tribenuron-methyl	P	Tribenuron-methyl	101200-48-0	methyl 2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-methylcarbamoyl]sulfamoyl]benzoate	09-06-2001	3
Tribenuron-methyl	M	M2	220225-04-7	1-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-1-methylurea	29-06-2022	217
Tribenuron-methyl	M	IN-R9805	879554-45-7	4-methyl-6-(methylamino)-1,3,5-triazin-2(1H)-one pyridinyl-2-hydroxyethyl-2-N-{2-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]-2-hydroxyethyl}-2-(trifluoromethyl)benzamide	29-06-2022	217
Tribenuron-methyl	M	Triazinamin-methyl	5248-39-5	4-methoxy-6-methyl-1,3,5-triazin-methylamine	29-08-2012	2344
Triflusulfuron-methyl	P	Triflusulfuron-methyl	126535-15-7	methyl 2-[4-dimethylamino-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-ylcarbamoylsulfamoyl]-m-toluate	30-06-2011	430
Triflusulfuron-methyl	M	IN-E7710	101988-70-9	N-methyl-6-(2,2,2-trifluoroethoxy)-1,3,5-triazine-2,4-diamine	30-06-2011	430
Triflusulfuron-methyl	M	IN-D8526	145963-84-4	N,N-dimethyl-6-(2,2,2-trifluoroethoxy)-1,3,5-triazine-2,4-diamine	30-06-2011	430
Triflusulfuron-methyl	M	IN-M7222	1418095-28-9	6-(2,2,2-trifluoroethoxy)-1,3,5-triazine-2,4-diamine	30-06-2011	430

\* Triazinamin/IN-A4098 is a common degradation product from the 1,3,5-triazine sulfonylurea herbicides.

\*\*Amitrol was included in the monitoring of pyroxulam as it was suspected to be a groundwater pollutant in the Danish groundwater monitoring programme (GRUMO) in relation to the yearly screenings in 2019. Pyroxulam was therefore tested as a theoretical source of origin to amitrol. The findings of amitrol in the groundwater screening were later shown to be an analytical artefact and the monitoring of amitrol in PLAP was thus suspended.



## Appendix 2 - Sampling programme and drainage sampling

### Sampling programme

From each of the PLAP fields, samples of groundwater, drainage water and soil water in the variably saturated zone are collected. A full description of the original monitoring design is found in Lindhardt *et al.* (2001), and later revisions and changes to the sampling procedure are described in previous reports (see [www.plap.dk](http://www.plap.dk)).

Table A2.1 provides an overview of the sampling programme for each of the active PLAP fields. Tylstrup was set on standby (January 1, 2019) and in connection with this, the sampling programme for the other fields was revised. In general, fewer samples are collected from the fields compared to earlier reporting periods. The sampling programme is under constant revision as new knowledge about the hydrogeological conditions at the PLAP fields is continuously collected and processed.

**Table A2.1.** Pesticide monitoring programme in suction cups (S), horizontal monitoring wells (H) and vertical monitoring wells (M) July 2018-June 2022. Numbers in parentheses denote the number of samples collected from the well.

Field	Period	Monthly monitoring (Intensive)	Half-yearly monitoring (medium)	Half-yearly monitoring (Extensive)	Not monitored
Jynde vad	before 1/1-2019	M1(2), M4(2), M7(3), S1a, S2a, H1(1) <sup>m</sup>	M1(2), M2(3), M4(2), M7(3), S1a, S2a, H1(1) <sup>m</sup>	M1(2), M2(3), M4(2), M5(2), M7(3), S1a, S2a, H1(1) <sup>m</sup>	M3, M6, S1b, S2b
	1/1-2019-30/6 2020	M1(2), M4(2), M7(2), S1a, S2a, H1(1) <sup>m</sup>	M1(2), M2(2), M4(2), M7(2), S1a, S2a, H1(1) <sup>m</sup>	M1(2), M2(2), M4(2), M5(2), M7(2), S1a, S2a, H1(1) <sup>m</sup>	M3, M6, S1b, S2b
Silstrup	1/7-2018-30/6-2020	M5(2), M9(1), H1.2, H3(1) <sup>m</sup>	-	M5(2), M9(2), M10(2), M12(2), H1.2, H3(1) <sup>m</sup>	M1-M4, M6-M8, M11, M13, H2
Estrup	before 1/1-2019	M4(2), M6(1), H1.2, H2(1) <sup>m</sup>	-	M1(2), M4(2), M5(2), M6(2), H1.2 H2(1) <sup>m</sup>	M2, M3, M7, S1, S2
	1/1-2019-30/6 2020	M4(2), H1.2, H2(1) <sup>m</sup>	-	M1(2), M4(2), M5(2), M6(2), H1.2 H2(1) <sup>m</sup>	M2, M3, M7, S1, S2
Faardrup	before 1/1-2019	M4(2), M5(2), M6(2), H2.3, H3 <sup>m</sup>	-	M2(2), M4(2), M5(2), M6(2), H2.3, H3 <sup>m</sup>	M1, M3, M7, H1, S1, S2
	1/1-2019-30/6 2020	M4(2), M5(1), H2.3, H3 <sup>m</sup>	-	M2(2), M4(2), M5(2), M6(2), H2.3, H3 <sup>m</sup>	M1, M3, M7, H1, S1, S2
Lund	before 1/1-2019	M1(2), M4(2), M5(2), M6(2)	-	M1(2), M2(2), M3(2), M4(2), M5(2), M6(2), M7(2)	S1, S2
	1/1-2019-30/6 2020	M1(1), M4(2), M5(2)	-	M1(2), M4(2), M5(2), M6(2)	M2, M3, S1, S2

S1a and S1b refer to suction cups installed 1 and 2 mbgs, respectively, at location S1, whereas S2a and S2b refer to suction cups installed 1 and 2 mbgs, respectively, at location S2.

<sup>m</sup> Mixed water samples from three screens.

## Drainage sampling

Until July 2004, pesticide analyses were performed weekly on water sampled time-proportionally from the drainage system. Moreover, during storm events additional samples (sampled flow-proportionally over 1–2 days) were also analysed for pesticides. In June 2004, the drainage monitoring programme was revised. From July 2004 and onwards pesticide analysis was done weekly on water sampled flow proportionally from the drainage water system. See Kjær *et al.* 2003 for further details on the methods of flow-proportional sampling. The weighted average concentration of pesticides in the drainage water was calculated according to the following equation:

$$C = \frac{\sum_{i=1}^n M_i}{\sum_{i=1}^n V_i}$$

$$M_i = C_i \cdot V_i$$

where:

n = Number of weeks within the period of continuous drainage runoff

V<sub>i</sub> = Weekly accumulated drainage runoff (mm/week)

C<sub>i</sub> = Pesticide concentration collected by means of flow-proportional sampler (µg/L). ND is included as 0 µg/L calculating average concentrations.

Until July 2004 when both time and flow-proportional sampling were applied, the numbers were:

$$M_i = C_{t_i} \cdot V_i \quad \text{If no flow event occurs within the } i\text{'th week}$$

$$M_i = C_{f_i} \cdot V_{f_i} \quad \text{If a flow event occurs within the } i\text{'th week and if } C_{f_i} \cdot V_{f_i} > C_{t_i} \cdot V_i$$

where:

n = Number of weeks within the period of continuous drainage runoff

V<sub>i</sub> = Weekly accumulated drainage runoff (mm/week)

V<sub>f<sub>i</sub></sub> = Drainage runoff accumulated during a “flow event” (mm/storm event)

C<sub>f<sub>i</sub></sub> = Pesticide concentration in the “event samples” collected by means of the flow-proportional sampler (µg/L)

C<sub>t<sub>i</sub></sub> = Pesticide concentration in the weekly samples collected by means of the time-proportional sampler (µg/L)

The tables in Appendix 7 report the weighted average leachate concentration in the drainage water within the first drainage season after application prior to the current monitoring period. In these tables, this calculation period is defined as the period from application until 1 July the following year, as pesticides are usually present in the first drainage runoff occurring after application of pesticide.

On the sandy soils, the weighted average concentration of pesticides leached to the suction cups situated 1 mbgs was estimated using the measured pesticide concentration and estimated percolation on a monthly basis. Pesticide concentrations measured in suction cups S1 and S2 were assumed to be representative for each sample period. Moreover, accumulated percolation rates deriving from the MACRO model were assumed to be representative for both suction cups S1 and S2. For each of the measured concentrations, the corresponding percolation (Perc.) was estimated according to the equation:

$$P_i = \sum_{t_1}^{t_2} P_t$$

where:

t = sampling date;  $t_1 = 0.5(t_{i-1} + t_i)$ ;  $t_2 = 0.5(t_i + t_{i+1})$

$P_t$  = daily percolation at 1 mbgs as estimated by the MACRO model (mm)

The average concentration was estimated according to the equation:

$$C = \frac{\sum C_i \cdot P_i}{\sum P_i}$$

where:

$C_i$  = measured pesticide concentration in the suction cups located 1 mbgs

Table A7.1A-B and Table A7.2A-B in Appendix 7 report the weighted average leachate concentration. In these tables, this calculation period is defined as the period from the date of first detection until 1 July the following year. On sandy soils, the transport of pesticides down to the suction cups situated at 1 m depth may take some time. In most cases the first detection of pesticides occurs around 1 July, why the reported concentration represents the yearly average concentration. In a few cases, the first detection of pesticides occurs later, but this later occurrence does not affect the weighted average calculation. E.g. the reported average concentration using a calculation period from the first detection until 1 July the following year is equal to that using a calculation period of a year (1 July–30 June) the following year. Unless noted the concentrations listed in Table A7.1A-B and Table A7.2A-B in Appendix 7 can therefore be considered as yearly average concentrations. In the few cases where reported concentrations are either not representative of an annual average concentration or not representative of the given leaching pattern (leaching increases the second or third year after application), a note is inserted in the table.

In the current report, no new results of weighted average leachate concentration are presented as the method of inferring these calculations is under revision.

**Appendix 3**

**Agricultural management**

**Table A3.1.** Management practice at **Tylstrup** during 2012 to 2022 growing seasons. The active ingredients of the various pesticides are indicated in parentheses.

Date	Management practice and growth stages – Tylstrup
22-03-2012	Ploughed - depth 24 cm
24-03-2012	Spring barley sown, cv. TamTam, seeding rate 185 kg ha <sup>-1</sup> , sowing depth 2.75 cm, row distance 12.5 cm. Using combine driller with a tubular packer roller. Final plant number 344 m <sup>-2</sup> . Sown with rotor harrow combine sowing machine
03-04-2012	BBCH stage 6-7
10-04-2012	BBCH stage 09
19-04-2012	BBCH stage 11
29-04-2012	BBCH stage 12
29-04-2012	Fertilisation - 123.9 N, 17.7 P, 59 K, kg ha <sup>-1</sup>
30-04-2012	BBCH stage 12
09-05-2012	BBCH stage 14
16-05-2012	BBCH stage 20
21-05-2012	BBCH stage 22
21-05-2012	Biomass 72.2 g m <sup>-2</sup> - 100% DM
21-05-2012	Fox 480 SC (bifenox) - weeds - 1.2 L ha <sup>-1</sup> (not analysed)
25-05-2012	Mustang Forte (aminopyralid/florasulam/2,4-D) - weeds - 0.75 L ha <sup>-1</sup>
25-05-2012	BBCH stage 29
31-05-2012	BBCH stage 32
31-05-2012	Irrigation - 24 mm.
06-06-2012	BBCH stage 37
12-06-2012	BBCH stage 44
19-06-2012	BBCH stage 50
19-06-2012	Biomass 644.8 g m <sup>-2</sup> - 100% DM
28-06-2012	BBCH stage 59
28-06-2012	Bell (boscalid + epoxiconazole) - fungi - 1.5 L ha <sup>-1</sup> (epoxiconazole not analysed)
02-07-2012	BBCH stage 61
10-07-2012	BBCH stage 79
10-07-2012	Biomass 1138.3 g m <sup>-2</sup> - 100% DM
24-07-2012	BBCH stage 83
06-08-2012	BBCH stage 86
13-08-2012	BBCH stage 88
13-08-2012	Glyfonova 450 Plus (glyphosate) - weeds - 2.4 L ha <sup>-1</sup> (not analysed)
27-08-2012	BBCH stage 89
27-08-2012	Harvest of spring barley. Stubble height 15 cm, grain yield 62.0 hkg ha <sup>-1</sup> - 85% DM. Straw removed, yield 37.3 hkg ha <sup>-1</sup> - 100% DM
31-08-2012	Tracer (potassium bromide), 30 kg ha <sup>-1</sup>
20-09-2012	Ploughed - Depth 22 cm
23-09-2012	Winter rye sown, cv. Magnifico, seeding rate 64.0 kg ha <sup>-1</sup> , sowing depth 3.5 cm, row distance 13.0 cm. Final plant number 125 m <sup>-2</sup> . Sown with rotor harrow combine sowing machine
05-10-2012	BBCH stage 09 - emergence
10-10-2012	BBCH stage 11
12-10-2012	BBCH stage 12
12-10-2012	Boxer (prosulfocarb) - weeds - 4.0 L ha <sup>-1</sup>
22-10-2012	BBCH stage 12
05-11-2012	BBCH stage 13
14-11-2012	BBCH stage 20
26-11-2012	BBCH stage 22
26-11-2012	Biomass 7.0 g m <sup>-2</sup> - 100% DM
04-04-2013	Fertilisation - 56.7 N, 8.1 P, 27.0 K, kg ha <sup>-1</sup>
04-04-2013	BBCH stage 22
02-05-2013	BBCH stage 30-31
02-05-2013	Fertilisation - 71.4 N, 10.2 P, 34.0 K, kg ha <sup>-1</sup>
07-05-2013	BBCH stage 31
08-05-2013	Starane XL (fluroxypyr) - weeds - 1.2 L ha <sup>-1</sup>
24-05-2013	BBCH stage 50
24-05-2013	Biomass 422.8 g m <sup>-2</sup> - 100% DM

Date	Management practice and growth stages – Tylstrup
28-05-2013	BBCH stage 57
31-05-2013	BBCH stage 59
10-06-2013	BBCH stage 67
18-06-2013	BBCH stage 70
25-06-2013	BBCH stage 72
02-07-2013	Biomass 1275.2 g m <sup>-2</sup> - 100% DM
02-07-2013	BBCH stage 76
09-07-2013	BBCH stage 79
18-07-2013	BBCH stage 81
05-08-2013	BBCH stage 87
13-08-2013	BBCH stage 89
20-08-2013	Harvest of winter rye. Stubble height 15 cm, grain yield 77.4 hkg ha <sup>-1</sup> - 85% DM. Straw removed, yield 33.8 hkg ha <sup>-1</sup> - 100% DM
26-02-2014	Ploughed - depth 23 cm
02-04-2014	Seed bed preparation, 5 cm depth and packed with a roller
03-04-2014	Fertilisation - 175.5 N, kg ha <sup>-1</sup>
03-04-2014	Fertilisation - 100 K, kg ha <sup>-1</sup>
15-04-2014	Maxim 100 FS (fludioxonil) - fungi - 250 mL ton <sup>-1</sup> potatoes ~ 625 mL ha <sup>-1</sup> a sprayed on potatoes before the planting
15-04-2014	Seed bed preparation diagonally - depth 20 cm
15-04-2014	Planting of potatoes. cv. Kuras row distance 75 cm, plant distance 25 cm, depth 17 cm, final plant number 4 m <sup>-2</sup>
16-04-2014	BBCH stage 00
16-04-2014	Command CS (clomazone) - weeds - 0.25 L ha <sup>-1</sup> (not monitored)
25-04-2014	BBCH stage 01
30-04-2014	BBCH stage 03
05-05-2014	BBCH stage 05
15-05-2014	BBCH stage 08 to 09
15-05-2014	Titus WSB (rimsulfuron) - weeds - 10 g ha <sup>-1</sup> (not monitored)
17-05-2014	BBCH stage 09 – emergence
22-05-2014	Titus WSB (rimsulfuron) + U46 M (MCPA) - weeds - 20 g ha <sup>-1</sup> + 100 mL ha <sup>-1</sup> (not monitored)
22-05-2014	BBCH stage 13
27-05-2014	BBCH stage 15
04-06-2014	BBCH stage 15
10-06-2014	BBCH stage 27
13-06-2014	BBCH stage 45
13-06-2014	Irrigation - 24 mm.
18-06-2014	BBCH stage 47
18-06-2014	Biomass tubers 119.0 g Top 233.3 g m <sup>-2</sup> - 100% DM
20-06-2014	BBCH stage 53
20-06-2014	Irrigation - 24 mm.
26-06-2014	BBCH stage 59
26-06-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
02-07-2014	Biomass tubers 388.9 g. Top 391.2 g m <sup>-2</sup> - 100% DM
02-07-2014	BBCH stage 60
03-07-2014	BBCH stage 60
04-07-2014	Irrigation - 24 mm.
04-07-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
14-07-2014	BBCH stage 69
14-07-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
23-07-2014	BBCH stage 75
23-07-2014	Irrigation - 24 mm.
24-07-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
24-07-2014	BBCH stage 75
30-07-2014	Irrigation 30 mm.
02-08-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
11-08-2014	BBCH stage 90
11-08-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>

Date	Management practice and growth stages – Tylstrup
13-08-2014	Biomass tubers 1,270.3 g. Top 266.3 g m <sup>-2</sup> - 100% DM
13-08-2014	BBCH stage 92
18-08-2014	BBCH stage 92
18-08-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
25-08-2014	BBCH stage 92
25-08-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
12-09-2014	Harvest of potatoes. Tuber yield 107.1 hkg ha <sup>-1</sup> - 100% DM
15-09-2014	Liming - 4.0 t ha <sup>-1</sup>
20-09-2014	Disk harrowed - depth 10 cm
20-09-2014	Stubble cultivated - depth 25 cm
22-09-2014	Sowing winter wheat, cv. Mariboss, sowing depth 3.0 cm, seeding rate 190 kg ha <sup>-1</sup> , row distance 12.5 cm, final plant number 248 m <sup>-2</sup>
29-09-2014	BBCH stage 07-08
29-09-2014	Fertilisation - 24.5 N, kg ha <sup>-1</sup>
02-10-2014	BBCH stage 09 – emergence
09-10-2014	BBCH stage 11
13-10-2014	BBCH stage 12
22-10-2014	BBCH stage 13
30-10-2014	BBCH stage 13
30-10-2014	Lexus 50 WG (flupyr sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.6 g a.i. ha <sup>-1</sup> )
14-11-2014	BBCH stage 14-15
14-11-2014	Orius 200 EW (tebuconazole) - fungi – 1.25 L ha <sup>-1</sup> (250 g a.i. ha <sup>-1</sup> )
17-12-2014	BBCH stage 22
17-12-2014	Biomass 16.1 g m <sup>-2</sup> - 100% DM
24-03-2015	BBCH stage 22
24-03-2015	Fertilisation - 49.6 N, 7.1 P, 23.6 K, kg ha <sup>-1</sup>
09-04-2015	BBCH stage 24
09-04-2015	Lexus 50 WG (flupyr sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.6 g a.i. ha <sup>-1</sup> )
22-04-2015	BBCH stage 30
30-04-2015	BBCH stage 31
05-05-2015	BBCH stage 31
05-05-2015	Fertilisation - 105 N, 15 P, 50 K, kg ha <sup>-1</sup>
14-05-2015	BBCH stage 32
14-05-2015	Starane XL (fluroxypyr + florasulam) - weeds - 1.2 L ha <sup>-1</sup> (120 g a.i. ha <sup>-1</sup> + 3 g a.i. ha <sup>-1</sup> )
14-05-2015	Proline EC 250 (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> )
26-05-2015	BBCH stage 33
12-06-2015	BBCH stage 49
12-06-2015	Proline EC 250 (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> )
15-06-2015	BBCH stage 51
15-06-2015	Biomass 890.1 g m <sup>-2</sup> - 100% DM
13-07-2015	BBCH stage 71
21-07-2015	BBCH stage 75
21-07-2015	Irrigation - 26 mm
13-08-2015	BBCH stage 82
13-08-2015	Biomass 1673 g m <sup>-2</sup> – 100% DM
20-08-2015	BBCH stage 88
20-08-2015	Broad sown catch crop of oil seed rape cv. Akiro, 16 kg ha <sup>-1</sup> (on top of the soil)
20-08-2015	Glyphogan (glyphosate) - weeds - 2.7 l ha <sup>-1</sup> (sprayed simultaneously with the sowing of the catch crop) (972 g a.i. ha <sup>-1</sup> ) (not monitored)
01-09-2015	BBCH stage 09 – emergence of catch crop
08-09-2015	BBCH stage 90
08-09-2015	Harvest of winter wheat. Stubble height 14 cm, grain yield 74.0 hkg ha <sup>-1</sup> 85% DM
10-09-2015	Straw removed, yield 46.4 hkg ha <sup>-1</sup> - 100% DM
22-03-2016	Ploughed - depth 23 cm
15-04-2016	Spring barley sown, cv. Evergreen, seeding rate 155 kg ha <sup>-1</sup> , sowing depth 2.8 cm, row distance 13 cm. Final plant number 272 m <sup>-2</sup> Sown with rotor harrow combine sowing machine
18-04-2016	Fertilisation – 168 N, 24 P, 80 K, kg ha <sup>-1</sup>

Date	Management practice and growth stages – Tylstrup
21-04-2016	Under sowing of clover grass catch crop (AgrowGrass 350 MidiMaize) seeding rate 13 kg ha <sup>-1</sup> , sowing depth 1 cm, row distance 12 cm
01-05-2016	BBCH stage 09 - emergence
10-05-2016	BBCH stage 12
19-05-2016	BBCH stage 23
19-05-2016	Biomass 47.8 g m <sup>-2</sup> – 100% DM
19-05-2016	Fighter 480 (bentazone) – weeds - 1.5 L ha <sup>-1</sup> (720 g a.i. ha <sup>-1</sup> )
19-05-2016	Catch crop – BBCH stage 11-12
02-06-2016	BBCH stage 36
09-06-2016	BBCH stage 50
09-06-2016	Irrigation - 27 mm
10-06-2016	BBCH stage 50
10-06-2016	Biomass 414.8 g m <sup>-2</sup> – 100% DM
24-06-2016	BBCH stage 54
04-07-2016	BBCH stage 58
13-07-2016	BBCH stage 75
13-07-2016	Biomass 1099.5 g m <sup>-2</sup> - 100% DM
21-07-2016	BBCH stage 80-81
27-07-2016	BBCH stage 87
19-08-2016	BBCH stage 91
19-08-2016	Harvest of spring barley. Stubble height 15 cm, grain yield 61.9 hkg ha <sup>-1</sup> - 85% DM
29-08-2016	Straw remove, yield 27.0 hkg ha <sup>-1</sup> - 100% DM
10-03-2017	Rotor harrowed - depth 7 cm
22-03-2017	Ploughed - depth 23 cm
28-03-2017	BBCH stage 00
28-03-2017	Spring barley sown, cv. Laurikka coated with Redigo Pro 170 FS, seeding rate 165 kg ha <sup>-1</sup> , sowing depth 4 cm, row distance 13 cm. Final plant number not determined.
04-04-2017	BBCH stage 06
06-04-2017	Fertilisation - 133 N, 19 P, 63 K, kg ha <sup>-1</sup>
11-04-2017	BBCH stage 09 - emergence
27-04-2017	BBCH stage 12
08-05-2017	BBCH stage 22
08-05-2017	Biomass 57.3 g m <sup>-2</sup> - 100% DM
09-05-2017	BBCH stage 22
09-05-2017	Hussar Plus OD (iodosulfuron-mesosulfuron) - weeds - 0.07 L ha <sup>-1</sup> (3.5 g iodosulfuron and 0.525 g mesosulfuron, a.i. ha <sup>-1</sup> )
11-05-2017	BBCH stage 23
23-05-2017	BBCH stage 31
29-05-2017	BBCH stage 37
01-06-2017	BBCH stage 41
01-06-2017	Bumper 25 EC (propiconazole) - fungi - 0.5 L ha <sup>-1</sup> (125 g propiconazole a.i. ha <sup>-1</sup> )
14-06-2017	BBCH stage 55
14-06-2017	Biomass 629.5 g m <sup>-2</sup> - 100% DM
14-06-2017	Bumper 25 EC (propiconazole) - fungi - 0.5 L ha <sup>-1</sup> (125 g propiconazole a.i. ha <sup>-1</sup> )
03-07-2017	BBCH stage 77
17-07-2017	BBCH stage 80-83
17-07-2017	Biomass 629.3 g m <sup>-2</sup> - 100% DM
14-08-2017	Harvest of spring barley. Stubble height 15 cm, grain yield 67.1 hkg ha <sup>-1</sup> - 85% DM
14-08-2017	Straw removed - 28.6 hkg ha <sup>-1</sup> 100% DM
15-08-2017	Winter rapeseed
15-08-2017	Stubble cultivated - depth 7 cm
16-08-2017	Stubble cultivated - depth 20 cm
17-08-2017	Winter rapeseed sown - cv. DK Exclaim, depth 2.0 cm, row distance 13 cm seed amount 1.8 kg ha <sup>-1</sup> , final plant number 54 m <sup>-2</sup>
18-08-2017	Command CS (clomazone) - weeds - 0.25 L ha <sup>-1</sup> (90 g clomazone a.i. ha <sup>-1</sup> )
24-08-2017	Fertilisation - 34 N, kg ha <sup>-1</sup>
30-08-2017	BBCH stage 09 - emergence

Date	Management practice and growth stages – Tylstrup
15-09-2017	Ploughed - depth 23 cm - due to poor emergence - crust had formed on surface due to heavy rain - impeding the emergence
16-09-2017	Winter barley sown, cv. Hejmdal, seeding rate 165 kg ha <sup>-1</sup> , sowing depth 4 cm, row distance 13 cm. Final plant number 320 m <sup>2</sup>
16-09-2017	Seed dressing Redigo Pro 170 FS (prothioconazole 12.38 g a.i. ha <sup>-1</sup> and tebuconazole 1.65 g a.i. ha <sup>-1</sup> )
23-09-2017	BBCH stage 09 - emergence
27-09-2017	BBCH stage 10
02-10-2017	BBCH stage 11
18-10-2017	BBCH stage 13
18-10-2017	Lexus 50 WG (flupyrsulfuron) - weeds - 10 g ha <sup>-1</sup> (4.63 g flupyrsulfuron)
09-11-2017	BBCH stage 20
09-11-2017	Biomass 31.8 g m <sup>-2</sup> - 100% DM
09-04-2018	BBCH stage 24
09-04-2018	Fertilisation - 256.4 N, 36.6 P, 121 K, kg ha <sup>-1</sup>
01-05-2018	BBCH stage 32
18-05-2018	BBCH stage 50
18-05-2018	Biomass 520.4 g m <sup>-2</sup> - 100% DM
18-05-2018	Irrigation - 40 mm.
24-05-2018	Irrigation - 25 mm.
05-06-2018	Irrigation - 18 mm.
06-06-2018	BBCH stage 75
06-06-2018	Biomass 1027.4 g m <sup>-2</sup> - 100% DM
09-06-2018	Irrigation - 27 mm
19-06-2018	BBCH stage 82
11-07-2018	BBCH stage 91
11-07-2018	Harvest of winter barley, Stubble height 12 cm. Grain yield 46.24 hkg ha <sup>-1</sup> . Total N 1.61% and total-C 43.54% - 85 % DM.
12-07-2018	Straw removed - 28.6 hkg ha <sup>-1</sup> 100% DM - 52.2 hkg ha <sup>-1</sup> , Total-N 0.61% and total-C 43.73% - 100% DM
28-09-2018	Liming - 3.0 t ha <sup>-1</sup>
12-03-2019	Ploughed - (depth not measured - likely depth 23 cm)
05-04-2019	Harrowed - depth unknown
12-04-2019	Spring oats sown
25-04-2019	BBCH stage 09 - emergence (estimated based on seven years sowing of spring barley on the location)
30-04-2019	Fertilisation - 95.5 N, 20.5 P, 102.3 K, kg ha <sup>-1</sup>
28-05-2019	BBCH stage 31
28-05-2019	U46M (MCPA) - weeds - 1 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) - not monitored
24-08-2019	Harvest of spring oats - grain yield 46.7 hkg ha <sup>-1</sup> - 85% DM
27-03-2020	Ploughed
28-03-2020	Fertilisation - 143.2 N, 20.6 P, 68.2 K, kg ha <sup>-1</sup>
07-04-2020	Sowing a mixture of spring barley varieties (to reduce need for fungicidal spraying)
20-04-2020	BBCH stage 09 - emergence (estimated based on past cultivation of spring barley at the field)
07-05-2020	BBCH stage 20-21
29-05-2020	BBCH stage 33
14-08-2020	Harvest of spring barley, stubbleheight 12 cm. Grain yield 46.24 hkg ha <sup>-1</sup> - 85 % DM
21-08-2020	Straw removed
07-10-2020	Glyphomax HL (glyphosate) - weeds - 3.4 L-ha (1636 g a.i. ha <sup>-1</sup> ) - not monitored
14-03-2021	Ploughed
19-03-2021	Furrows leveled out with cultivator
23-03-2021	Fertilisation - 143.2 N, 20.6 P, 68.2 K, kg ha <sup>-1</sup>
24-03-2021	Sowing a mixture of spring barley varieties (to reduce need for fungicidal spraying), seeding rate 182 kg ha <sup>-1</sup>
22-04-2021	BBCH stage 11
18-05-2021	BBCH stage 31
18-05-2021	U46 M (MCPA) - weeds - 1 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) - not monitored
18-08-2021	Harvest of spring barley. Grain yield 48.2 hkg ha <sup>-1</sup> - 85 % DM
20-08-2021	Straw removed, 20.5 hkg ha <sup>-1</sup> - fresh weight
21-03-2022	Ploughed
25-03-2022	Fertilisation - 142.8 N, 20.4 P, 68.0 K, kg ha <sup>-1</sup>
26-03-2022	Sowing a mixture of spring barley varieties, seeding rate 170 kg ha <sup>-1</sup>

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Date	Management practice and growth stages – <b>Tylstrup</b>
28-03-2022	Rolled
17-05-2022	Fertilisation, mangan profi - 1.5 L ha <sup>-1</sup> - 0.353 Mn, 0.165 N, kg ha <sup>-1</sup>
23-05-2022	U46 M (MCPA) - weeds - 1 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) - not monitored
30-05-2022	Fertilisation, manganese nitrate 235 - 1.5 L ha <sup>-1</sup> - 0.353 Mn, 0.165 N, kg ha <sup>-1</sup>

**Table A3.2.** Management practice at **Jyndeivad** during 2012 to 2022 growing seasons. The active ingredients of the various pesticides are indicated in parentheses.

Date	Management practice and growth stages – <b>Jyndeivad</b>
30-03-2012	Ploughed. Depth 22 cm
02-04-2012	Rolled with concrete roller
30-04-2012	Fertilisation 120 K, kg ha <sup>-1</sup>
30-04-2012	Fertilisation 140 N, 17.7 P, 65.3 K, kg ha <sup>-1</sup>
03-05-2012	Sowing maize - cv. Atrium - seed distance 12 cm, row distance 75 cm, depth 6 cm. Seed rate 111,000 seeds ha <sup>-1</sup> , final plant number 12.8 m <sup>-2</sup>
03-05-2012	Fertilisation 29.4 N, 14.7 P, kg ha <sup>-1</sup>
07-05-2012	Tracer (potassium bromide), 30.54 kg ha <sup>-1</sup>
17-05-2012	BBCH stage 09 – emergence
22-05-2012	BBCH stage 11
26-05-2012	BBCH stage 14-15
26-05-2012	Fighter 480 (bentazone) - weeds - 1.0 L ha <sup>-1</sup>
30-05-2012	BBCH stage 13
30-05-2012	Biomass 41.7 g m <sup>-2</sup> - 100% DM
05-06-2012	BBCH stage 15
05-06-2012	Callisto (mesotrione) - weeds - 1.5 L ha <sup>-1</sup>
06-06-2012	BBCH stage 15
15-06-2012	BBCH stage 16
15-06-2012	Tomahawk 180 EC (fluroxypyr) + Catch (florasulam + 2,4 D) -1.5 L ha <sup>-1</sup> + 0.06 L ha <sup>-1</sup> - weeds - (neither analysed)
18-06-2012	BBCH stage 17
25-06-2012	BBCH stage 19
02-07-2012	BBCH stage 31
10-07-2012	BBCH stage 35
17-07-2012	BBCH stage 51
18-07-2012	Biomass 2182.3 g m <sup>-2</sup> - 100% DM
23-07-2012	BBCH stage 53
30-07-2012	BBCH stage 59
05-08-2012	BBCH stage 63
14-08-2012	BBCH stage 66
17-08-2012	BBCH stage 67
17-08-2012	Biomass 8241.8 g m <sup>-2</sup> - 100% DM
20-08-2012	BBCH stage 68
27-08-2012	BBCH stage 72
03-09-2012	BBCH stage 74
13-09-2012	BBCH stage 82
19-09-2012	BBCH stage 83
24-09-2012	BBCH stage 84
24-09-2012	Dry matter content whole plants 25.4%
01-10-2012	BBCH stage 87
01-10-2012	Dry matter content whole plants 27.5%
08-10-2012	BBCH stage 88
08-10-2012	Dry matter content whole plants 33.0%
08-10-2012	Harvest of maize. Whole crop yield 151.41 hkg ha <sup>-1</sup> - 100% DM. Stubble height 25 cm
06-04-2013	Ploughing - 22 cm depth
12-04-2013	Rolled with concrete roller
14-04-2013	Sowing pea cv. Alvestra, depth 5 cm, row distance 12 cm, seed rate 235 kg ha <sup>-1</sup> , using a combine drill, final plant number 92 m <sup>-2</sup>
26-04-2013	BBCH stage 09 – emergence
03-05-2013	BBCH stage 12
07-05-2013	Fighter 480 (bentazone) + Stomp (pendimethalin) 0.4 L ha <sup>-1</sup> + 0.6 L ha <sup>-1</sup> - weeds (pendimethalin not analysed)
07-05-2013	BBCH stage 13-14
13-05-2013	BBCH stage 14
16-05-2013	BBCH stage 14-15
16-05-2013	Bentazone 480 (bentazone) + Stomp (pendimethalin) 0.5 L ha <sup>-1</sup> + 0.6 L ha <sup>-1</sup> - weeds (pendimethalin not analysed)
17-05-2013	Fertilisation 16.0 P, 83.2 K, kg ha <sup>-1</sup>
21-05-2013	BBCH stage 25

Date	Management practice and growth stages – Jynde vad
27-05-2013	BBCH stage 30
03-06-2013	BBCH stage 37
04-06-2013	Biomass 105.7 g m <sup>-2</sup> - 100% DM
06-06-2013	BBCH stage 38
06-06-2013	Irrigation - 30 mm
10-06-2013	BBCH stage 41
17-06-2013	BBCH stage 60
21-06-2013	Biomass 393.5 g m <sup>-2</sup> - 100% DM
25-06-2013	BBCH stage 65
01-07-2013	BBCH stage 67
09-07-2013	BBCH stage 68
09-07-2013	Irrigation - 30 mm
15-07-2013	BBCH stage 69
15-07-2013	Biomass 722.5 g m <sup>-2</sup> - 100% DM
16-07-2013	Pirimor G (pirimicarb) - pests - 0.25 kg ha <sup>-1</sup> (not analysed)
22-07-2013	BBCH stage 78
29-07-2013	BBCH stage 81
05-08-2013	Biomass 737.2 g m <sup>-2</sup> - 100% DM
05-08-2013	BBCH stage 90
07-08-2013	Harvest of pea - western half of the field - interrupted by rain. Seed yield 38.8 hkg ha <sup>-1</sup> - 86% DM. Straw yield 30.1 hkg ha <sup>-1</sup> - 100% DM, stubble height 10 cm. Straw shredded at harvest
14-08-2013	Harvest of the eastern half of the field - straw shredded at harvest
20-08-2013	Stubble cultivation - 8 cm depth
22-08-2013	Rotor harrowed - 7 cm depth
26-03-2014	Ploughing - 22 cm depth
09-04-2014	Rolled with concrete roller
10-04-2014	Fertilisation 180.0 N, 38.6 P, 192.9 K, kg ha <sup>-1</sup>
10-04-2014	Fertilisation 19.7 N, kg ha <sup>-1</sup>
15-04-2014	Planting potatoes. cv. Oleva, row distance 75 cm, plant distance 33 cm, depth 7 cm. Final plant number 4 m <sup>-2</sup>
15-04-2014	Maxim 100 FS (fludioxonil) - fungi - 625 mL ha <sup>-1</sup> sprayed at potatoes when planting
30-04-2014	BBCH stage 05-08 (crop not emerged yet)
30-04-2014	Command CS (clomazone) + Glyphogan (glyphosate) - weeds - 0.25 L ha <sup>-1</sup> + 1.5 L ha <sup>-1</sup> (neither included in monitoring)
06-05-2014	BBCH stage 08 (crop not emerged yet)
06-05-2014	Titus WSB (rimsulfuron) - weeds - 10 g ha <sup>-1</sup> (not included in monitoring)
14-05-2014	BBCH stage 09 – emergence
26-05-2014	BBCH stage 22
27-05-2014	Titus WSB (rimsulfuron) - weeds - 20 g ha <sup>-1</sup> (not included in monitoring)
02-06-2014	BBCH stage 29
10-06-2014	BBCH stage 38
12-06-2014	BBCH stage 39
12-06-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
14-06-2014	BBCH stage 47
14-06-2014	Irrigation - 20 mm
16-06-2014	BBCH stage 48
18-06-2014	BBCH stage 50
18-06-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup> + Mospilan SG (acetamiprid) - pests - 150 g ha <sup>-1</sup> (not included)
18-06-2014	Microcare - 1.0 L ha <sup>-1</sup> - manganese 0.368 kg ha <sup>-1</sup> + N 0.035 kg ha <sup>-1</sup>
19-06-2014	BBCH stage 50
19-06-2014	Irrigation - 25 mm
20-06-2014	Biomass tubers 195.3 g m <sup>-2</sup> - 100% DM. Top 299.5 g m <sup>-2</sup> row - 100% DM
23-06-2014	BBCH stage 50
27-06-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup> + Mospilan SG (acetamiprid) - pests - 150 g ha <sup>-1</sup> (not included)
27-06-2014	BBCH stage 65
30-06-2014	BBCH stage 66
01-07-2014	Biomass tubers 91.3 g m <sup>-2</sup> - 100% DM. Top 395.3 g m <sup>-2</sup> row - 100% DM
04-07-2014	BBCH stage 69
04-07-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>

Date	Management practice and growth stages – Jyndevad
08-07-2014	BBCH stage 69
12-07-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
12-07-2014	BBCH stage 70
18-07-2014	BBCH stage 72
18-07-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
18-07-2014	Microcare - 1.0 L ha <sup>-1</sup> - manganese 0.368 kg ha <sup>-1</sup> + N 0.035 kg ha <sup>-1</sup>
21-07-2014	BBCH stage 79
21-07-2014	Irrigation - 25 mm
24-07-2014	BBCH stage 81
24-07-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
29-07-2014	BBCH stage 82
29-07-2014	Irrigation - 25 mm
30-07-2014	Ranman (cyazofamid) - fungi - 0.2 L ha <sup>-1</sup>
30-07-2014	BBCH stage 85
04-08-2014	BBCH stage 86
04-08-2014	Irrigation - 25 mm
07-08-2014	BBCH stage 86
07-08-2014	Ranman (cyazofamid) - fungi - 0.2 L ha <sup>-1</sup>
11-08-2014	BBCH stage 93
12-08-2014	Biomass tubers 1881.1 g m <sup>-2</sup> - 100% DM. Top 211.5 g m <sup>-2</sup> row - 100% DM
14-08-2014	BBCH stage 93
14-08-2014	Dithane NT (mancozeb) - fungi - 2.0 L ha <sup>-1</sup>
01-09-2014	Rotor harrowed - 6 cm depth
16-09-2014	Harrowed diagonally - depth 6 cm.
18-09-2014	Winter wheat drilled directly in the potato stubble
26-09-2014	BBCH stage 09 – emergence
29-09-2014	BBCH stage 10
08-10-2014	BBCH stage 13
22-10-2014	BBCH stage 14
22-10-2014	Lexus 50 WG (flupyr-sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.6 g a.i. ha <sup>-1</sup> )
24-10-2014	BBCH stage 14
27-10-2014	BBCH stage 15
11-11-2014	BBCH stage 20
11-11-2014	Orius 200 EW (tebuconazole) - fungi – 1.25 L ha <sup>-1</sup> (250 g a.i. ha <sup>-1</sup> )
17-11-2014	BBCH stage 20
27-11-2014	BBCH stage 21
09-03-2015	BBCH stage 22
17-03-2015	BBCH stage 22
18-03-2015	Fertilisation 120.0 N, 15 P, 56 K, kg ha <sup>-1</sup>
20-03-2015	BBCH stage 22
20-03-2015	Lexus 50 WG (flupyr-sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.6 g a.i. ha <sup>-1</sup> )
07-04-2015	BBCH stage 23
15-04-2015	BBCH stage 30
15-04-2015	Biomass 64.5 g m <sup>-2</sup> - 100% DM
16-04-2015	Fertilisation 4 P, 20 K, kg ha <sup>-1</sup>
17-04-2015	Fertilisation 50.0 N, kg ha <sup>-1</sup>
20-04-2015	BBCH stage 31
28-04-2015	BBCH stage 32
04-05-2015	BBCH stage 33
08-05-2015	BBCH stage 34
	Opus + Comet (epoxiconazole and pyraclostrobin) - fungi - 1.0 L ha <sup>-1</sup> +1.0 L ha <sup>-1</sup> (125g a.i. ha <sup>-1</sup> and 250g a.i. ha <sup>-1</sup> )
13-05-2015	BBCH stage 35
18-05-2015	BBCH stage 37
26-05-2015	BBCH stage 43
01-06-2015	BBCH stage 47
09-06-2015	BBCH stage 55
09-06-2015	Biomass 949.1 g m <sup>-2</sup> - 100% DM
11-06-2015	BBCH stage 57

Date	Management practice and growth stages – Jyndevad
11-06-2015	Irrigation - 27 mm
16-06-2015	BBCH stage 59
17-06-2015	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> )
23-06-2015	BBCH stage 60
29-06-2015	BBCH stage 65
30-06-2015	BBCH stage 65
30-06-2015	Irrigation - 30 mm
06-07-2015	BBCH stage 75
08-07-2015	BBCH stage 75
08-07-2015	Biomass 1358.8 g m <sup>-2</sup> - 100% DM
13-07-2015	BBCH stage 79
13-07-2015	Irrigation - 30 mm
14-07-2015	BBCH stage 79
21-07-2015	BBCH stage 81
03-08-2015	BBCH stage 83
10-08-2015	BBCH stage 87
20-08-2015	Harvest of winter wheat. Grain yield 79.7 hkg ha <sup>-1</sup> 85% DM, straw yield 71.5 hkg ha <sup>-1</sup> 100% DM, stubbleheight 15 cm. Straw shredded (left in field) at harvest
20-08-2015	Rotor harrowed, 5-6 cm depth
07-03-2016	Ploughing - 22 cm depth
21-03-2016	Sowing spring barley cv. KWS Irena, depth 4.0 cm, row distance 12 cm, seed rate 170 kg ha <sup>-1</sup> , final plant number 345 m <sup>2</sup> - using a combine drill
21-03-2016	Rolled with concrete roller
21-03-2016	BBCH stage 00
30-03-2016	BBCH stage 09 - emergence
04-04-2016	BBCH stage 10
05-04-2016	BBCH stage 11
05-04-2016	Fertilisation 136.0 N, 17 P, 63 K, kg ha <sup>-1</sup>
20-04-2016	BBCH stage 12
20-04-2016	Sowing catch crop of grass and clover (Foragemax 42)
27-04-2016	BBCH stage 13
03-05-2016	BBCH stage 16
03-05-2016	Fighter 480 (bentazone) - weeds - 1.5 L ha <sup>-1</sup>
10-05-2015	BBCH stage 20
10-05-2016	Emergence of catch crop – BBCH stage 09
12-05-2016	Biomass 27.7 g m <sup>-2</sup> - 100% DM
17-05-2016	BBCH stage 27
23-05-2016	BBCH stage 32
31-05-2016	BBCH stage 37
02-06-2016	BBCH stage 50
02-06-2016	Bumper 25 EC (propiconazole) -fungi - 0.5 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> )
03-06-2016	Irrigation - 30 mm
03-06-2016	BBCH stage 50
03-06-2016	Biomass 721.7 g m <sup>-2</sup> - 100% DM
06-06-2016	BBCH stage 53
08-06-2016	BBCH stage 56
08-06-2016	Irrigation - 30 mm
13-06-2016	BBCH stage 57
20-06-2016	BBCH stage 58
27-06-2016	BBCH stage 67
06-07-2016	BBCH stage 72
12-07-2016	BBCH stage 75
12-07-2016	Biomass 1148.7 g m <sup>-2</sup> - 100% DM
25-07-2016	BBCH stage 89
01-08-2016	BBCH stage 90
08-08-2016	BBCH stage 95
17-08-2016	Harvest of spring barley. Seed yield 48.3 hkg ha <sup>-1</sup> 85% DM, stubble height 15 cm
30-08-2016	Removal of straw, straw yield 27.4 hkg ha <sup>-1</sup> 100% DM

Date	Management practice and growth stages – Jynde vad
03-02-2017	Ploughing - 22 cm depth
20-02-2017	Rolled with concrete roller
15-03-2017	Fertilisation 28 P, 147 K, kg ha <sup>-1</sup>
23-03-2017	Sowing pea cv. Mascara, depth 6.0 cm, row distance 12 cm, seed rate 235 kg ha <sup>-1</sup> , using a combine drill, final plant number 74 m <sup>-2</sup>
08-04-2017	BBCH stage 09 - emergence
08-04-2017	BBCH stage 10
17-04-2017	BBCH stage 11
23-04-2017	BBCH stage 12
09-05-2017	BBCH stage 33
09-05-2017	Stomp CS (pendimethalin) - weeds - 1.0 L ha <sup>-1</sup> (455 gr a.i. ha <sup>-1</sup> ) (not included)
09-05-2017	Fighter 480 (bentazone) - weeds - 1.0 L ha <sup>-1</sup> (480 gr a.i. ha <sup>-1</sup> )
19-05-2017	BBCH stage 52
19-05-2017	Biomass 335.1 g m <sup>-2</sup> - 100% DM
19-05-2017	Focus Ultra (cycloxydim) - weeds - 5.0 L ha <sup>-1</sup> (500 g a.i. ha <sup>-1</sup> )
27-05-2017	BBCH stage 59
27-05-2017	Irrigation - 30 mm
30-05-2017	BBCH stage 60
08-06-2017	BBCH stage 64
08-06-2017	Biomass 64.8 g m <sup>-2</sup> - 100% DM
16-06-2017	BBCH stage 69
22-06-2017	BBCH stage 70
22-06-2017	Irrigation - 30 mm
27-06-2017	BBCH stage 71
27-06-2017	Biomass 704.3 g m <sup>-2</sup> - 100% DM
10-07-2017	BBCH stage 75
18-07-2017	BBCH stage 78
26-07-2017	BBCH stage 82
26-07-2017	Biomass 1003.3 g m <sup>-2</sup> - 100% DM
28-07-2017	BBCH stage 82
07-08-2017	BBCH stage 85
10-08-2017	BBCH stage 89
18-08-2017	Harvest of pea. Seed yield 64.4 hkg ha <sup>-1</sup> 86 % DM. Straw yield 38.9 hkg ha <sup>-1</sup> 100% DM, stubble height 10 cm. Straw shredded at harvest
18-08-2017	Rotor harrowed - incorporation of the straw and stubble, 6 cm depth
08-09-2017	Ploughing - 22 cm depth
10-09-2017	Rolled with concrete roller
21-09-2017	Sowing winter wheat cv. Sheriff (Redigo Pro 170 FS as seed dressing) Depth 4.0 cm, seeding rate 168 kg ha <sup>-1</sup> , row distance 12.5 cm. Final plant number 320m <sup>-2</sup>
03-10-2017	BBCH stage 09 - emergence
16-10-2017	BBCH stage 12
16-10-2017	Lexus 50 WG (flupyr-sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.63 g a.i. ha <sup>-1</sup> )
27-03-2018	BBCH stage 20
03-04-2018	BBCH stage 23
04-04-2018	Fertilisation 54 N, kg ha <sup>-1</sup>
17-04-2018	BBCH stage 27
17-04-2018	Biomass 36.8 g m <sup>-2</sup> - 100% DM
20-04-2018	BBCH stage 28
20-04-2018	Hussar Plus OD - weeds - 0.14 L ha <sup>-1</sup> (7 g a.i. ha <sup>-1</sup> iodosulfuron-methyl-Na and 1.05 g a.i. ha <sup>-1</sup> mesosulfuron-methyl)
27-04-2018	Pig slurry (sow) application - trail hose applied at surface - 45 t ha <sup>-1</sup> - 110.4 Total-N, 73.9 NH <sub>4</sub> -N, 27.5 P, 55.4K, kg ha <sup>-1</sup> , DM of slurry 2.18 %
03-05-2018	BBCH stage 31
03-05-2018	Lexus 50 WG (flupyr-sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.63 g a.i. ha <sup>-1</sup> )
05-05-2018	BBCH stage 32
08-05-2018	BBCH stage 33
08-05-2018	U46M (MCPA) - weeds - 1 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) (not included)
13-05-2018	BBCH stage 41
13-05-2018	Irrigation - 30 mm

Date	Management practice and growth stages – Jynde vad
14-05-2018	BBCH stage 41
20-05-2018	BBCH stage 45
20-05-2018	Irrigation - 30 mm
24-05-2018	BBCH stage 50
24-05-2018	Biomass 65.0 g m <sup>-2</sup> - 100% DM
27-05-2018	BBCH stage 52
27-05-2018	Irrigation - 30 mm
02-06-2018	BBCH stage 65
02-06-2018	Irrigation - 30 mm
04-06-2018	BBCH stage 69
06-06-2018	BBCH stage 70
06-06-2018	Topsin WG (thiophanat-methyl) - fungi - 1.1 kg ha <sup>-1</sup> (770 g a.i ha <sup>-1</sup> )
06-06-2018	Irrigation - 30 mm
10-06-2018	BBCH stage 70
10-06-2018	Irrigation - 30 mm
13-06-2018	BBCH stage 72
22-06-2018	BBCH stage 73
26-06-2018	BBCH stage 74
26-06-2018	Irrigation - 30 mm
04-07-2018	BBCH stage 75
04-07-2018	Irrigation - 30 mm
09-07-2018	BBCH stage 75
09-07-2018	Biomass 3386.7 g m <sup>-2</sup> - 100% DM
17-07-2018	BBCH stage 80
25-07-2018	BBCH stage 89
26-07-2018	Harvest of winter wheat. Grain yield 82.4 hkg ha <sup>-1</sup> 85% DM, straw yield 44.8 hkg ha <sup>-1</sup> 100% DM, stubble height 14 cm. Straw removed at harvest
22-08-2018	Glyfonova MAX HL (glyphosate) - weeds - 3.2 L ha <sup>-1</sup> (1536 g a.i. ha <sup>-1</sup> )
18-10-2018	Ploughing - 20 cm depth
18-10-2018	Sowing winter rye cv. Bono. Depth 4.0 cm, seeding rate 105 kg ha <sup>-1</sup> , row distance 12.0 cm. Final plant number 220 m <sup>-2</sup>
18-10-2018	Celeste Formula M - 210 mL ha <sup>-1</sup> (5.25 g a.i. ha <sup>-1</sup> fludioxonil) - seed dressing
05-11-2018	BBCH stage 09 - emergence
21-03-2019	BBCH stage 22
21-03-2019	Fertilisation 136 N, 26 P, 65 K, kg ha <sup>-1</sup>
28-03-2019	BBCH stage 25
08-04-2019	BBCH stage 27
11-04-2019	BBCH stage 28
11-04-2019	Irrigation - 30 mm ha <sup>-1</sup>
12-04-2019	BBCH stage 29
12-04-2019	Biomass 77.0 g m <sup>-2</sup> - 100% DM
17-04-2019	BBCH stage 30
17-04-2019	Fertilisation 63 N, 12 P, 30 K, kg ha <sup>-1</sup>
19-04-2019	BBCH stage 30
22-04-2019	BBCH stage 30
22-04-2019	Irrigation - 30 mm
25-04-2019	BBCH stage 31
25-04-2019	Talius (proquinazid) - fungi - 0.25 L ha <sup>-1</sup> (50 g a.i. ha <sup>-1</sup> )
05-05-2019	BBCH stage 38
05-05-2019	Irrigation - 30 mm
08-05-2019	BBCH stage 40
08-05-2019	Cerone (ethephone) - plant growth regulation - 1.0 L ha <sup>-1</sup> (480 g a.i. ha <sup>-1</sup> ) - not monitored
08-05-2019	U46M (MCPA) - weeds - 1.0 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) - not monitored
09-05-2019	BBCH stage 41
09-05-2019	Talius (proquinazid) - fungi - 0.25 L ha <sup>-1</sup> (50 g a.i. ha <sup>-1</sup> )
13-05-2019	BBCH stage 45
13-05-2019	Biomass 616.9 g m <sup>-2</sup> - 100% DM
20-05-2019	BBCH stage 48

Date	Management practice and growth stages – Jyndevad
24-05-2019	BBCH stage 50
24-05-2019	Irrigation - 30 mm
27-05-2019	BBCH stage 51
08-06-2019	BBCH stage 57
08-06-2019	Irrigation - 30 mm
10-06-2019	BBCH stage 59
24-06-2019	BBCH stage 65
26-06-2019	BBCH stage 66
26-06-2019	Irrigation - 30 mm
04-07-2019	BBCH stage 75
04-07-2019	Irrigation - 30 mm
09-07-2019	BBCH stage 77
09-07-2019	Biomass 1851.8 g m <sup>-2</sup> - 100% DM
22-07-2019	BBCH stage 85
02-08-2019	BBCH stage 89
11-08-2019	BBCH stage 91
11-08-2019	Harvest of winter rye. Grain yield 69.2 hkg ha <sup>-1</sup> - 85% DM, straw yield 36.5 hkg ha <sup>-1</sup> - 100% DM, stubble height 22 cm. Straw removed at harvest.
03-02-2020	Ploughing - 22 cm depth
25-04-2020	Planting of potatoes. cv. Kuras row distance 75 cm, plant distance 30 cm, depth 14 cm, final plant number
25-04-2020	Fertilisation - 28 N, 6 P, 30 K, kg ha <sup>-1</sup> placed when planting the potato tubers
25-04-2020	168 N, 135 K, kg ha <sup>-1</sup> with a pneumatic fertiliser spreader
20-05-2020	BBCH stage 08
20-05-2020	Glyphomax HL (glyphosate) - 2 L ha <sup>-1</sup> (960 g a.i. ha <sup>-1</sup> ) and Centium 36 CS (clomazone) - 0.25 L ha <sup>-1</sup> (90 g a.i. ha <sup>-1</sup> ) - weeds - neither monitored
24-05-2020	BBCH stage 09 - emergence
01-06-2020	BBCH stage 14
13-06-2020	BBCH stage 28
13-06-2020	Irrigation - 20 mm
14-06-2020	BBCH stage 28
14-06-2020	Ranman Top (cyazofamid) - fungi – 0.5 L ha <sup>-1</sup> (80 g a.i. ha <sup>-1</sup> )
17-06-2020	Mechanical weeding - depth 5 cm (Einbøck Rollstar) - row hoe with rolling hoe stars
21-06-2020	BBCH stage 40
21-06-2020	Irrigation - 20 mm
23-06-2020	BBCH stage 41
23-06-2020	Ranman Top (cyazofamid) - fungi - 0.5 L ha <sup>-1</sup> (80 g a.i. ha <sup>-1</sup> )
23-06-2020	Mospilan SG (acetamiprid) - pests – 0.25 kg ha <sup>-1</sup> (50 a.i. ha <sup>-1</sup> )
23-06-2020	Biomass root 55.7 g m <sup>-2</sup> and top 537.6 g m <sup>-2</sup> - 100 % DM
01-07-2020	BBCH stage 64
01-07-2020	Biomass root 164.6 g m <sup>-2</sup> and top 901.1 g m <sup>-2</sup> - 100 % DM
03-07-2020	BBCH stage 65
03-07-2020	Dithane NT (mancozeb) - fungi - 2.0 kg ha <sup>-1</sup> (1500 g a.i. ha <sup>-1</sup> ) - not monitored
09-07-2020	BBCH stage 67
09-07-2020	Dithane NT (mancozeb) - fungi - 2.0 kg ha <sup>-1</sup> (1500 g a.i. ha <sup>-1</sup> ) - not monitored
17-07-2020	BBCH stage 68
17-07-2020	Ranman Top (cyazofamid) - fungi - 0.5 L ha <sup>-1</sup> (80 g a.i. ha <sup>-1</sup> )
17-07-2020	Mospilan SG (acetamiprid) - pests - 0.25 kg ha <sup>-1</sup> (50 a.i. ha <sup>-1</sup> )
27-07-2020	BBCH stage 69
27-07-2020	Dithane NT (mancozeb) - fungi - 2.0 kg ha <sup>-1</sup> (1500 g a.i. ha <sup>-1</sup> ) - not monitored
02-08-2020	BBCH stage 70
02-08-2020	Irrigation - 30 mm
03-08-2020	BBCH stage 70
03-08-2020	Dithane NT (mancozeb) - fungi - 2.0 kg ha <sup>-1</sup> (1500 g a.i. ha <sup>-1</sup> ) - not monitored
06-08-2020	BBCH stage 74
06-08-2020	Proxanil (propamocarb and cymoxanil) - fungi - 2.5 L ha <sup>-1</sup> (834 g a.i. ha <sup>-1</sup> propamocarb and 125 g a.i. ha <sup>-1</sup> cymoxanil) - neither analysed
08-08-2020	BBCH stage 75
08-08-2020	Irrigation - 30 mm ha <sup>-1</sup>

Date	Management practice and growth stages – Jyndevad
12-08-2020	BBCH stage 77
12-08-2020	NeemAzal-T/S (azadirachtin) - pests - 2.5 L ha <sup>-1</sup> (65 g a.i. ha <sup>-1</sup> )
12-08-2020	Ranman Top (cyazofamid) - fungi - 0.5 L ha <sup>-1</sup> (80 g a.i. ha <sup>-1</sup> )
15-08-2020	BBCH stage 79
15-08-2020	Irrigation - 30 mm
19-08-2020	BBCH stage 81
19-08-2020	Proxanil (propamocarb and cymoxanil) - fungi - 2.5 L ha <sup>-1</sup> (834 g a.i. ha <sup>-1</sup> propamocarb and 125 g a.i. ha <sup>-1</sup> cymoxanil) - neither analysed
27-08-2020	BBCH stage 87
27-08-2020	Dithane NT (mancozeb) - fungi - 2.0 kg ha <sup>-1</sup> (1500 g a.i. ha <sup>-1</sup> ) - not monitored
27-08-2020	Biomass root 293.2 g m <sup>-2</sup> and top 1263.3 g m <sup>-2</sup> - 100 % DM
01-09-2020	BBCH stage 89
01-09-2020	NeemAzal-T/S (azadirachtin) - pests - 2.5 L ha <sup>-1</sup> (65 g a.i. ha <sup>-1</sup> )
01-09-2020	Ranman Top (cyazofamid) - fungi - 0.5 L ha <sup>-1</sup> (80 g a.i. ha <sup>-1</sup> )
10-09-2020	BBCH stage 91
10-09-2020	Ranman Top (cyazofamid) - fungi - 0.5 L ha <sup>-1</sup> (80 g a.i. ha <sup>-1</sup> )
16-09-2020	BBCH stage 95
16-09-2020	Dithane NT (mancozeb) - fungi - 2.0 kg ha <sup>-1</sup> (1500 g a.i. ha <sup>-1</sup> ) - not monitored
21-10-2020	Harvest of potatoes. Yield in tubers 142.8 hkg ha <sup>-1</sup> - 100% DM
21-10-2020	Rotor cultivated - incorporation of potato leaves and stems, 5 cm
21-10-2020	Sowing winter rye cv. Serafino. Depth 4.0 cm, seeding rate 159 kg ha <sup>-1</sup> , row distance 12.0 cm. Final plant number 320 m <sup>-2</sup>
21-10-2020	Redigo Pro 170 FS - 79.5 mL ha <sup>-1</sup> (11.9 g a.i. ha <sup>-1</sup> prothioconazole and 1.6 g a.i. ha <sup>-1</sup> tebuconazol) - seed dressing
05-11-2020	BBCH stage 09 - emergence
08-03-2021	BBCH stage 22
08-03-2021	Fertilisation 54.6 N, 10.4 P, 26.0 K, kg ha <sup>-1</sup>
31-03-2021	BBCH stage 22
07-04-2021	BBCH stage 27
07-04-2021	Fertilisation 79.8 N, 15.4 P, 38.0 K, kg ha <sup>-1</sup>
14-04-2021	BBCH stage 28
14-04-2021	Biomass 44.6 g m <sup>-2</sup> - 100% DM
20-04-2021	BBCH stage 31
20-04-2021	U46M (MCPA) - weeds - 1 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) - not monitored
27-04-2021	BBCH stage 32
27-04-2021	Irrigation - 30 mm
05-05-2021	BBCH stage 35
11-05-2021	BBCH stage 45
19-05-2021	BBCH stage 49
19-05-2021	Biomass 550.3 g m <sup>-2</sup> - 100% DM
26-05-2021	BBCH stage 60
08-06-2021	Irrigation - 27 mm
09-06-2021	BBCH stage 65
16-06-2021	BBCH stage 67
16-06-2021	Irrigation - 35 mm
28-06-2021	BBCH stage 71
06-07-2021	BBCH stage 76
06-07-2021	Biomass 1892.3 g m <sup>-2</sup> - 100% DM
20-07-2021	BBCH stage 81
08-08-2021	BBCH stage 85
20-08-2021	BBCH stage 89
20-08-2021	Harvest of winter rye. Grain yield 59.6 hkg ha <sup>-1</sup> - 85% DM. Straw yield 42.3 hkg ha <sup>-1</sup> - 100% DM, stubbleheight 12 cm. Straw shredded (left in field) at harvest
30-08-2021	Liming 3.6 t ha <sup>-1</sup> magnesium limestone
01-02-2022	Ploughing - 22 cm depth
02-02-2022	Disc harrowed, 8-10 cm depth
05-03-2022	Sowing spring barley cv. Flair, sowing depth 4.0 cm, seeding rate 182 kg ha <sup>-1</sup> , row distance 12.0 cm. Final plant number 346 m <sup>-2</sup>
05-03-2022	Redigo Pro 170 FS - 91.0 mL ha <sup>-1</sup> (13.65 g a.i. ha <sup>-1</sup> prothioconazole and 1.82 g a.i. ha <sup>-1</sup> tebuconazol) - seed dressing

Date	Management practice and growth stages – Jynde vad
26-03-2022	BBCH stage 10 - emergence
28-03-2022	BBCH stage 11
28-03-2022	Fertilisation 46.2 N, 8.8 P, 21.0 K, kg ha <sup>-1</sup>
13-04-2022	BBCH stage 15
23-04-2022	BBCH stage 22
23-04-2022	Nuance Max 75 WG (tribenuron-methyl) - weeds - 10 g ha <sup>-1</sup> (7.5 g a.i. ha <sup>-1</sup> ) - monitored
27-04-2022	Fertilisation 46.2 N, 8.8 P, 21.0 K, kg ha <sup>-1</sup>
28-04-2022	BBCH stage 22
28-04-2022	Biomass 35.8 g m <sup>-2</sup> - 100% DM
28-04-2022	Irrigation - 20 mm
05-05-2022	BBCH stage 27
05-05-2022	Fertilisation 46.2 N, 8.8 P, 21.0 K, kg ha <sup>-1</sup>
07-05-2022	BBCH stage 28
07-05-2022	Irrigation - 20 mm
18-05-2022	BBCH stage 38
18-05-2022	U46 M (MCPA) - weeds - 1 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) - not monitored
19-05-2022	Irrigation - 25 mm
22-05-2022	BBCH stage 49
22-05-2022	Biomass 329.6 g m <sup>-2</sup> - 100% DM
22-05-2022	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 1 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> prothioconazole and 125 g a.i. ha <sup>-1</sup> fluopyram) - monitored
05-06-2022	BBCH stage 55
05-06-2022	Irrigation - 25 mm
12-06-2022	BBCH stage 62
22-06-2022	BBCH stage 71
22-06-2022	Irrigation - 20 mm
28-06-2022	BBCH stage 75
28-06-2022	Biomass 3424.3 g m <sup>-2</sup> - 100% DM

**Table A3.3.** Management practice at **Silstrup** during 2012 to 2022 growing seasons. The active ingredients of the various pesticides are indicated in parentheses.

Date	Management practice and growth stages – <b>Silstrup</b>
15-03-2012	Fertilisation 60 N, 32 S, kg ha <sup>-1</sup>
13-04-2012	DFF (diflufenican) - weeds - 0.15 L ha <sup>-1</sup>
13-04-2012	BBCH stage 25
13-04-2012	Biomass 176.5 g m <sup>-2</sup> - 100% DM
19-04-2012	BBCH stage 25
19-04-2012	Fusilade Max (fluazifop-P-butyl) - weeds - 1.5 L ha <sup>-1</sup>
10-05-2012	BBCH stage 41
15-05-2012	BBCH stage 51
18-05-2012	BBCH stage 52
18-05-2012	Folicur (tebuconazole) - fungi - 1.0 L ha <sup>-1</sup>
22-05-2012	Biomass 441.9 g m <sup>-2</sup> - 100% DM
22-05-2012	BBCH stage 57
07-06-2012	BBCH stage 60
22-06-2012	BBCH stage 67
03-07-2012	BBCH stage 85
05-07-2012	BBCH stage 85
05-07-2012	Biomass 915.3 g m <sup>-2</sup> - 100% DM
25-07-2012	Harvest of grass seed. Yield 14.16 hkg ha <sup>-1</sup> - 87% DM
25-07-2012	Straw removed - straw yield 48.3 hkg ha <sup>-1</sup> - 100% DM, stubble height 12 cm
25-07-2012	BBCH stage 89
10-09-2012	Tracer (potassium bromide) 30.0 kg ha <sup>-1</sup>
10-09-2012	Glyfonova 450 Plus (glyphosate) - weeds (killing the red fescue) - 4.8 L ha <sup>-1</sup>
08-10-2012	Ploughed - depth 24 cm – packed
09-10-2012	Sowing winter wheat cv. Hereford. Depth 2.4 cm, seeding rate 200 kg ha <sup>-1</sup> , row distance 15.0 cm using a Horch Pronto 6 DC
17-10-2012	BBCH stage 5
24-10-2012	BBCH stage 09
24-10-2012	BBCH stage 09
31-10-2012	BBCH stage 10
09-11-2012	BBCH stage 10
09-11-2012	DFF (diflufenican) + Oxitril CM (ioxynil + bromoxynil - not analysed) - weeds - 0.12 g ha <sup>-1</sup> + 0.2 L ha <sup>-1</sup>
14-11-2012	BBCH stage 11
28-11-2012	BBCH stage 12
08-01-2013	BBCH stage 12
22-02-2013	BBCH stage 12
22-02-2013	Fertilisation 52.5 N, 7.5 P, 25.0 K, kg ha <sup>-1</sup>
03-05-2013	Sowing spring barley cv. Quenc, replacing winter wheat injured by frost. Depth 3.8 cm, seeding rate 175 kg ha <sup>-1</sup> , row distance 15 cm, Horch Pronto 6 DC, final plant number 303 m <sup>-2</sup>
03-05-2013	The remaining winter wheat plants incorporated at the sowing of spring barley
04-05-2013	Fertilisation 67.2 N, 9.6 P, 32.0 K, kg ha <sup>-1</sup>
14-05-2013	BBCH stage 08
16-05-2013	BBCH stage 09
22-05-2013	BBCH stage 12
29-05-2013	BBCH stage 22
29-05-2013	Biomass 23.3 g m <sup>-2</sup> - 100% DM
30-05-2013	BBCH stage 22
30-05-2013	Duotril 400 EC (ioxynil + bromoxynil) - weeds - 0.6 L ha <sup>-1</sup>
11-06-2013	BBCH stage 30
25-06-2013	BBCH stage 47
25-06-2013	Amistar (azoxystrobin) - fungi - 1.0 L ha <sup>-1</sup>
01-07-2013	Folicur 250 EC (tebuconazole) - fungi - 1.0 L ha <sup>-1</sup>
01-07-2013	BBCH stage 50
01-07-2013	Biomass 537.0 g m <sup>-2</sup> - 100% DM
09-07-2013	BBCH stage 58
19-07-2013	BBCH stage 70
06-08-2013	BBCH stage 80

Date	Management practice and growth stages – <b>Silstrup</b>
06-08-2013	Biomass 1332.1 g m <sup>-2</sup> - 100% DM
14-08-2013	BBCH stage 86
20-08-2013	Glyfonova 450 Plus (glyphosate) - weeds (killing the grass) - 2.4 L ha <sup>-1</sup>
20-08-2013	BBCH stage 87
30-08-2013	BBCH stage 89
06-09-2013	Harvest of spring barley. Grain yield 59.8 hkg ha <sup>-1</sup> - 85% DM, straw yield 46.0 hkg ha <sup>-1</sup> - 100% DM, stubble height 14 cm. Straw shredded at harvest
20-09-2013	Liming 3.2 t ha <sup>-1</sup>
23-09-2013	Ploughed - depth 24 cm – packed
25-09-2013	Sowing winter wheat cv. Hereford. Depth 4 cm, seeding rate 190 kg ha <sup>-1</sup> , final plant number 346 m <sup>-2</sup> , row distance 15.0 cm using a Horch Pronto 6 DC
01-10-2013	BBCH stage 06
07-10-2013	BBCH stage 09 – emergence
16-10-2013	BBCH stage 10
16-10-2013	Oxitril CM (bromoxynil + ioxynil) + DFF (diflufenican) - weeds – 0.08 L ha <sup>-1</sup> + 0.2 L ha <sup>-1</sup> (bromoxynil and ioxynil not included)
30-10-2013	BBCH stage 12
05-11-2013	BBCH stage 13
20-11-2013	BBCH stage 13
04-12-2013	BBCH stage 13
07-04-2014	Fertilisation 170.5 N, 23.3 P, 77.5 K, kg ha <sup>-1</sup>
07-04-2014	BBCH stage 13
15-04-2014	BBCH stage 20
25-04-2014	BBCH stage 30
25-04-2014	Biomass 94.0 g m <sup>-2</sup> - 100% DM
30-04-2014	BBCH stage 30
15-05-2014	BBCH stage 32
21-05-2014	BBCH stage 34
27-05-2014	BBCH stage 41
02-06-2014	Biomass 962.0 g m <sup>-2</sup> - 100% DM
02-06-2014	BBCH stage 51
03-06-2014	BBCH stage 53
04-06-2014	Amistar (azoxystrobin) - fungi - 1.0 L ha <sup>-1</sup>
18-06-2014	BBCH stage 63
23-06-2014	BBCH stage 68
02-07-2014	Biomass 1776.5 g m <sup>-2</sup> - 100% DM
02-07-2014	BBCH stage 75
08-07-2014	BBCH stage 76
16-07-2014	BBCH stage 79
22-07-2014	BBCH stage 83
25-07-2014	BBCH stage 87
25-07-2014	Glyfonova 450 Plus (glyphosate) - weeds - 2.4 L ha <sup>-1</sup>
15-08-2014	BBCH stage 90
16-08-2014	Harvest of winter wheat. Grain yield 83.5 hkg ha <sup>-1</sup> - 85% DM, straw yield 113.8 hkg ha <sup>-1</sup> - 100% DM, stubble height 14 cm. Straw shredded (left in field) at harvest
19-09-2014	Stubble harrowed, disk harrow (Heva Disc Roller) - depth 5-8 cm (incorporation of straw)
28-04-2015	Pig slurry application - acidified at application - trail hose applied at surface - 28.3 t ha <sup>-1</sup> – 126.2 Total-N, 75.6 NH <sub>4</sub> -N, 44.2 P, 46.7 K, kg ha <sup>-1</sup> , DM of slurry 5.33%
28-04-2015	Ploughed - 24 cm depth
30-04-2015	Fertilisation 112.5 K kg ha <sup>-1</sup>
30-04-2015	Seedbed preparation, 5-8 cm depth
02-05-2015	Sowing maize cv. Ambition, depth 3.5 cm, row distance 75 cm, seed distance 14 cm seeding rate 10 m <sup>2</sup> . final plant number 7.4 m <sup>2</sup> (seeds were coated with thirame, fludioxonil and metalaxyl-M)
02-05-2015	Fertilisation 30 N, 12.9 P, kg ha <sup>-1</sup> (placed at sowing)
03-05-2015	BBCH stage 01
12-05-2015	BBCH stage 05
19-05-2015	BBCH stage 07
27-05-2015	BBCH stage 09 - emergence

Date	Management practice and growth stages – <b>Silstrup</b>
27-05-2015	Callisto (mesotrione) + Harmony SX (thifensulfuron-methyl) - weeds - (0.75 L ha <sup>-1</sup> + 5.625 g ha <sup>-1</sup> ) (i.e. 75 g a.i. ha <sup>-1</sup> + 2.813 g a.i. ha <sup>-1</sup> )
06-06-2015	BBCH stage 12
09-06-2015	BBCH stage 12
09-06-2015	Callisto (mesotrione) + MaisTer (foramsulfuron + iodosulfuron) - weeds - (0.75 L ha <sup>-1</sup> + 100 g ha <sup>-1</sup> ) (i.e. 75 g a.i. ha <sup>-1</sup> + 30 g a.i. ha <sup>-1</sup> + 1 g a.i. ha <sup>-1</sup> )
18-06-2015	BBCH stage 14
23-06-2015	BBCH stage 15
23-06-2015	MaisTer (foramsulfuron + iodosulfuron) - weeds - (50 g ha <sup>-1</sup> ) (15 g a.i. ha <sup>-1</sup> + 0.5 g a.i. ha <sup>-1</sup> )
03-07-2015	BBCH stage 17-18
03-07-2015	Biomass 5.8 g m <sup>-2</sup> - 100% DM
14-07-2015	BBCH stage 19
22-07-2015	BBCH stage 31
12-08-2015	BBCH stage 51
13-08-2015	BBCH stage 51
13-08-2015	Biomass 303.8 g m <sup>-2</sup> - 100% DM
19-08-2015	BBCH stage 54
26-08-2015	BBCH stage 65
09-09-2015	BBCH stage 70
23-09-2015	BBCH stage 72
30-09-2015	BBCH stage 73
05-10-2015	BBCH stage 74
05-10-2015	Biomass 1086.2 g m <sup>-2</sup> - 100% DM
21-10-2015	BBCH stage 77
28-10-2015	BBCH stage 80
31-10-2015	Harvest of maize. Stubble height 25 cm. Total harvested yield 64.98 hkg ha <sup>-1</sup> - 100% DM.
05-11-2015	Maize stubble crushed with a cutter
28-04-2016	Stubble cultivated - depth 6 cm
09-05-2016	Pig slurry application – acidified at application – trail hose applied at surface – 34 t ha <sup>-1</sup> - 150.6 Total-N, 85.0 NH <sub>4</sub> -N, 70.7 P, 73.4 K, kg ha <sup>-1</sup> , DM of slurry 4.79%
10-05-2016	Ploughed - 24 cm depth - packed with a ring roller
11-05-2016	Fertilisation 89.6 K kg ha <sup>-1</sup>
12-05-2016	Rotary cultivated - depth 5.0 cm
13-05-2016	Fertilisation 33.4 N, 17.5 P, kg ha <sup>-1</sup> (placed at sowing)
13-05-2016	Sowing maize cv. Activate, depth 3.5 cm, row distance 75 cm, seed distance 14.7 cm seeding rate 10 m <sup>2</sup> . Final plant number 8 m <sup>2</sup> (seeds were coated with Mesurool FS 500 - thirame, fludioxonil and metalaxyl-M) (not monitored)
13-05-2016	BBCH stage 01
25-05-2016	BBCH stage 07
30-05-2016	BBCH stage 09 – emergence
02-06-2016	BBCH stage 12
06-06-2016	BBCH stage 13-14
06-06-2016	Callisto (mesotrione) + Harmony SX (thifensulfuron-methyl) - weeds - (0.75 L ha <sup>-1</sup> + 5.625 g ha <sup>-1</sup> ) (75 g a.i. ha <sup>-1</sup> + 2.813 g a.i. ha <sup>-1</sup> )
08-06-2016	BBCH stage 14
08-06-2016	Biomass 3.3 g m <sup>-2</sup> - 100% DM
22-06-2016	BBCH stage 16-17
22-06-2016	Callisto (mesotrione) + MaisTer (foramsulfuron + iodosulfuron) - weeds - (0.75 L ha <sup>-1</sup> + 150 g ha <sup>-1</sup> ) (i.e. 75 g a.i. ha <sup>-1</sup> + 45 g a.i. ha <sup>-1</sup> + 1.5 g a.i. ha <sup>-1</sup> )
27-06-2016	BBCH stage 17-18
29-06-2016	BBCH stage 19-21
06-07-2016	BBCH stage 31
13-07-2016	BBCH stage 32-33
20-07-2016	BBCH stage 34-50
25-07-2016	BBCH stage 51
25-07-2016	Biomass 428.1 g m <sup>-2</sup> - 100% DM
15-08-2016	BBCH stage 67
15-08-2016	Biomass 925.8 g m <sup>-2</sup> - 100% DM

Date	Management practice and growth stages – Silstrup
15-09-2016	BBCH stage 75
20-09-2016	Dry matter determination - 27.25%
29-09-2016	Dry matter determination - 29,74%
05-10-2016	Dry matter determination - 31.2%
11-10-2016	Harvest of maize. Stubble height 33 cm. Total harvested yield 120.86 hkg ha <sup>-1</sup> - 100% DM.
13-10-2016	Maize stubble crushed with a cutter
14-10-2016	Stubble cultivated - depth 6 cm
12-11-2016	Ploughed - 24 cm depth
28-04-2017	Seedbed preparation - depth 5 cm
28-04-2017	Fertilisation 30.5 N, 4.4 P, 14.5 K, kg ha <sup>-1</sup>
29-04-2017	Spring barley sown, cv. KWS Irina, seeding rate 160 kg ha <sup>-1</sup> , sowing depth 3.4 cm, row distance 12.5 cm. Final plant number not determined
29-04-2017	Seed dressing Redigo Pro 170 FS (12.0 g prothioconazole and 1.60 g tebuconazole g a.i. ha <sup>-1</sup> )
11-05-2017	BBCH stage 09 - emergence
15-05-2017	BBCH stage 12
29-05-2017	BBCH stage 21-22
29-05-2017	Pig slurry application - acidified at application - trail hose applied at surface - 30 t ha <sup>-1</sup> - 110.4 Total-N, 69.3 NH <sub>4</sub> -N, 44.4 P, 51.9 K, kg ha <sup>-1</sup> , DM of slurry 4.88 %
29-05-2017	Biomass 50.7 g m <sup>-2</sup> - 100% DM
29-05-2017	BBCH stage 32
12-06-2017	BBCH stage 33
15-06-2017	Zypar (halauxifen-methyl + florasulam (not monitored)) - weeds - 1.0 L ha <sup>-1</sup> (6.25 g a.i. ha <sup>-1</sup> halauxifen-methyl + 5 g florasulam)
27-06-2017	BBCH stage 50
27-06-2017	Biomass 526.1 g m <sup>-2</sup> - 100% DM
27-06-2017	Bumper 25 EC (propiconazole) - fungi - 0.5 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> propiconazole)
04-07-2017	BBCH stage 57
10-07-2017	BBCH stage 64
10-07-2017	Bumper 25 EC (propiconazole) - fungi - 0.5 l ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> propiconazole)
19-07-2017	BBCH stage 70
26-07-2017	BBCH stage 75
01-08-2017	BBCH stage 80
29-08-2017	BBCH stage 89
02-09-2017	Harvest of spring barley. Stubble height 15 cm, grain yield 61.2 hkg ha <sup>-1</sup> - 85% DM,
02-09-2017	Straw removed, straw yield 13.19 hkg ha <sup>-1</sup> - 100% DM
26-09-2017	Ploughed - 25 cm depth
28-09-2017	Seedbed preparation - depth 10 cm
28-09-2017	Fertilisation 12.6 N, 14.0 P, kg ha <sup>-1</sup> (placed at sowing)
28-09-2017	Winter barley sown, cv. Kosmos, seeding rate 190 kg ha <sup>-1</sup> , sowing depth 3.0 cm, row distance 13 cm, final plant number 216 m <sup>-2</sup>
28-09-2017	Seed dressing Redigo Pro 170 FS (prothioconazole 14.25 g and tebuconazole 1.9 g a.i. ha <sup>-1</sup> )
09-10-2017	BBCH stage 09 - emergence
18-10-2017	BBCH stage 11
18-10-2017	Lexus (flupyrsulfuron) - weeds - 10 g ha <sup>-1</sup> (4.63 g a.i. ha <sup>-1</sup> )
27-10-2017	BBCH stage 12-13
10-04-2018	BBCH stage 20
10-04-2018	Fertilisation 171.7 N, 24.5 P, 81.8 K, kg ha <sup>-1</sup>
18-04-2018	BBCH stage 22
18-04-2018	Biomass 461.8 g m <sup>-2</sup> - 100% DM
19-04-2018	BBCH stage 22
19-04-2018	Hussar Plus OD - weeds - 0.05 L ha <sup>-1</sup> (2.5 g a.i. ha <sup>-1</sup> iodoflurofen-methyl-Na and 0.375 g a.i. ha <sup>-1</sup> mesoflurofen-methyl)
23-05-2018	Biomass 691.8 g m <sup>-2</sup> - 100% DM
23-05-2018	BBCH stage 53
23-05-2018	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> )
01-06-2018	BBCH stage 65
01-06-2018	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> )
06-06-2018	BBCH stage 77

Date	Management practice and growth stages – <b>Silstrup</b>
06-06-2018	Biomass 1165.3 g m <sup>-2</sup> - 100% DM
21-06-2018	BBCH stage 83
20-07-2018	BBCH stage 89
20-07-2018	Harvest of winter barley. Stubble height 10 cm, grain yield 71.9 hkg ha <sup>-1</sup> . Total N 1.65% and total C 43.48% - 85% DM
24-07-2018	Straw removed, straw yield 10.3 hkg ha <sup>-1</sup> . Total-N 0.37% and total-C 42.45% - 100% DM
17-08-2018	Sowing winter rapeseed cv. DK Exclaim, sowing depth 2-3 cm, seeding rate 3.3 kg ha <sup>-1</sup> , row distance 45 cm, final plant number 33 m <sup>-2</sup>
17-08-2018	Seed dressing Thiram
23-08-2018	BBCH stage 09 – emergence
29-08-2018	BBCH stage 10
17-09-2018	BBCH stage 13 – 14
17-09-2018	Focus Ultra (cycloxydim) - weeds - 1.8 L ha <sup>-1</sup> - weeds - (180 g a.i. ha <sup>-1</sup> )
26-09-2018	BBCH stage 15
10-10-2018	BBCH stage 15
17-10-2018	BBCH stage 16
24-10-2018	BBCH stage 16
24-10-2018	Biomass 71.8 g m <sup>-2</sup> - 100% DM
09-11-2018	BBCH stage 18
09-11-2018	Kerb 400 SC (propyzamide) - weeds - 1.25 L ha <sup>-1</sup> (500 g a.i. ha <sup>-1</sup> )
01-03-2018	BBCH stage 30
01-03-2018	Fertilisation 81.0 N, kg ha <sup>-1</sup>
02-04-2019	BBCH stage 52
02-04-2019	Pig slurry application - acidified at application 2 L 96% H <sub>2</sub> SO <sub>4</sub> (ton slurry) <sup>-1</sup> - trail hose applied at surface - 22.7 T ha <sup>-1</sup> - 92.8 Total-N, 57.2 NH <sub>4</sub> -N, 21.6 P, 37.0 K, kg ha <sup>-1</sup> , DM of slurry 4.19 %
04-04-2019	BBCH stage 53
04-04-2019	Biomass 271.4 g m <sup>-2</sup> - 100% DM
09-04-2019	BBCH stage 54
09-04-2019	Agil 100 EC (propaquizifop) - weeds - 1.2 L ha <sup>-1</sup> (120 g a.i. ha <sup>-1</sup> )
16-04-2019	BBCH stage 55
24-04-2019	BBCH stage 60
29-04-2019	BBCH stage 63
08-05-2019	BBCH stage 66
15-05-2019	BBCH stage 68
28-05-2019	BBCH stage 76
04-06-2019	BBCH stage 79
02-07-2019	BBCH stage 80
17-07-2019	BBCH stage 83
24-07-2019	BBCH stage 85
14-08-2019	BBCH stage 90
14-08-2019	Harvest of winter rapeseed. Seed yield 44.5 hkg ha <sup>-1</sup> - 91% DM. Stubble height 41 cm, straw shredded at harvest - amount not determined.
26-08-2019	Rapeseed stubble crushed with a mower
19-09-2019	Ploughed - 25 cm depth
20-09-2019	Seedbed preparation - depth 7 cm
21-09-2019	Sowing winter wheat, cv. Benchmark, seeding rate 190 kg ha <sup>-1</sup> , sowing depth 5.0 cm, row distance 12.5 cm. Final plant number 240 m <sup>-2</sup>
21-09-2019	Celest Formula M, 380 mL ha <sup>-1</sup> (9.5 g a.i. ha <sup>-1</sup> fludioxonil) - seed dressing (not monitored)
07-10-2019	BBCH stage 09 - emergence
18-03-2020	BBCH stage 21
18-03-2020	Biomass 47.8 g m <sup>-2</sup> - 100% DM
25-03-2020	BBCH stage 21
25-03-2020	Fertilisation 177.2 N, 25.3 P, 84.4 K, kg ha <sup>-1</sup>
07-04-2020	BBCH stage 30
07-04-2020	Broadway - weeds - 165 g ha <sup>-1</sup> (11.27 g a.i. ha <sup>-1</sup> pyroxsulam and 3.76 g a.i. ha <sup>-1</sup> florasulam)
15-04-2020	BBCH stage 30
27-04-2020	BBCH stage 32
07-05-2020	BBCH stage 32

Date	Management practice and growth stages – <b>Silstrup</b>
19-05-2020	BBCH stage 37-39
26-05-2020	BBCH stage 41
28-05-2020	BBCH stage 42
28-05-2020	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> ) and Amistar (azoxystrobin) - fungi – 0.5 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> )
03-06-2020	BBCH stage 50
08-06-2020	BBCH stage 53
08-06-2020	Biomass 1072.7 g m <sup>-2</sup> - 100% DM
16-06-2020	BBCH stage 68
16-06-2020	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> ) and Amistar (azoxystrobin) - fungi - 0.5 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> )
08-07-2020	BBCH stage 75
08-07-2020	Biomass 1798.2 g m <sup>-2</sup> - 100% DM
15-07-2020	BBCH stage 77
22-07-2020	BBCH stage 79
13-08-2020	BBCH stage 89
13-08-2020	Harvest of winter wheat. Grain yield 97.0 hkg ha <sup>-1</sup> - 85% DM. Straw yield estimated between 98 and 106 hkg ha <sup>-1</sup> - 100% DM, stubbleheight 15 cm. Straw shredded (left in field) at harvest
28-09-2020	Ploughed - 25 cm depth
30-09-2020	Sowing winter wheat, cv. Skyscraper, seeding rate 250 kg ha <sup>-1</sup> , sowing depth 0-3.0 cm, row distance 12 cm
30-09-2020	Difend (difenoconazol) - seed dressing
10-10-2020	BBCH stage 09 - emergence
31-03-2021	Glyphomax HL (glyphosate) - winter wheat and weeds - 1.5 L ha <sup>-1</sup> (720 g a.i. ha <sup>-1</sup> ) - not monitored
15-04-2021	Seedbed preparation
15-04-2021	Sowing spring barley, mixture of varieties, seeding rate 200 kg ha <sup>-1</sup> , sowing depth 5.0 cm, row distance 12 cm
15-04-2021	Fertilisation 136.9 N, 19.6 P, 65.2 K, kg ha <sup>-1</sup>
29-04-2021	BBCH stage 09 - emergence
05-05-2021	BBCH stage 11
11-05-2021	BBCH stage 12
26-05-2021	BBCH stage 22
27-05-2021	Biomass 41.8 g m <sup>-2</sup> - 100% DM
10-06-2021	BBCH stage 33
10-06-2021	U46M (MCPA) - weeds - 1 L ha <sup>-1</sup> (750 g a.i. ha <sup>-1</sup> ) - not monitored
10-06-2021	Fertilisation, Profimangan - 1 L ha <sup>-1</sup> , 0.11 N, 0.24 Mn, kg ha <sup>-1</sup>
16-06-2021	BBCH stage 42
23-06-2021	BBCH stage 55
23-06-2021	Biomass 497.8 g m <sup>-2</sup> - 100% DM
29-06-2021	BBCH stage 61
30-06-2021	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 1 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> prothioconazole and 125 g a.i. ha <sup>-1</sup> fluopyram) - monitored
15-07-2021	BBCH stage 72
15-07-2021	Biomass 946.0 g m <sup>-2</sup> - 100% DM
23-08-2021	Harvest of spring barley. Grain yield 53.7 hkg ha <sup>-1</sup> - 85% DM
23-08-2021	Straw shredded (left in field) at harvest. Amount not determined
19-09-2021	Ploughed - 25 cm
20-09-2021	Seedbed preparation - 3 cm
21-09-2021	Sowing winter wheat, cv. Herup, seeding rate 200 kg ha <sup>-1</sup> , sowing depth 4.0 cm, row distance 12.5 cm
21-09-2021	Seedron (fludioxonil and tebuconazol) - seed dressing
13-10-2021	BBCH stage 11
03-11-2021	BBCH stage 12
17-11-2021	BBCH stage 21
17-11-2021	Biomass 11.6 g m <sup>-2</sup> - 100% DM
30-03-2022	BBCH stage 22
05-04-2022	Fertilisation 197.4 N, 28.2 P, 94.0 K, kg ha <sup>-1</sup>
26-04-2022	BBCH stage 31
29-04-2022	Express Gold 33 SX (tribenuron-methyl and metsulfuron-methyl) - weeds - 18 g ha <sup>-1</sup> (4 g a.i. ha <sup>-1</sup> tribenuron-methyl and 2 g a.i. ha <sup>-1</sup> metsulfuron-methyl) - monitored

Date	Management practice and growth stages – <b>Silstrup</b>
04-05-2022	BBCH stage 32
04-05-2022	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 0.5 L ha <sup>-1</sup> (62.5 g a.i. ha <sup>-1</sup> prothioconazole and 62.5 g a.i. ha <sup>-1</sup> fluopyram) - monitored
18-05-2022	BBCH stage 37
01-06-2022	BBCH stage 51
01-06-2022	Biomass 915.7 g m <sup>-2</sup> - 100% DM
10-06-2022	BBCH stage 60
10-06-2022	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 0.5 L ha <sup>-1</sup> (62.5 g a.i. ha <sup>-1</sup> prothioconazole and 62.5 g a.i. ha <sup>-1</sup> fluopyram) - monitored
22-06-2022	BBCH stage 67
29-06-2022	BBCH stage 72-73

**Table A3.4.** Management practice at **Estrup** during 2012 to 2022 growing seasons. The active ingredients of the various pesticides are indicated in parentheses.

Date	Management practice and growth stages – <b>Estrup</b>
09-11-2012	Ploughed - depth 20 cm - packed with a Dalbo ring roller
22-03-2012	Fertilisation 117 N, 15 P, 55 K, kg ha <sup>-1</sup>
29-03-2012	Rotor harrowed - depth 4 cm
30-03-2012	Spring barley sown, cv. Keops, seeding rate 159 kg ha <sup>-1</sup> , sowing depth 4.3 cm, row distance 12 cm. Final plant number 330 m <sup>-2</sup>
03-04-2012	Rolled with a Cambridge roller
22-04-2012	BBCH stage 09 – emergence
23-04-2012	BBCH stage 10
26-04-2012	BBCH stage 11
01-05-2012	BBCH stage 12
15-05-2012	BBCH stage 22
15-05-2012	Biomass 30.5 g m <sup>-2</sup> - 100% DM
15-05-2012	Fox 480 SC (bifenox) - weeds - 1.2 L ha <sup>-1</sup>
18-05-2012	BBCH stage 23
18-05-2012	Mustang Forte (aminopyralid-florasulam/2,4-D) - weeds - 0.75 L ha <sup>-1</sup> (florasulam/2,4-D not monitored)
21-05-2012	BBCH stage 30
21-05-2012	Fertilisation manganese nitrate (23.5%) - 2.0 L ha <sup>-1</sup>
29-05-2012	BBCH stage 37
29-05-2012	Fertilisation manganese nitrate (23.5%) - 2.0 L ha <sup>-1</sup>
06-06-2012	BBCH stage 40
13-06-2012	BBCH stage 50
13-06-2012	Amistar (azoxystrobin) - fungi - 1.0 L ha <sup>-1</sup>
14-06-2012	BBCH stage 50
14-06-2012	Biomass 528.5 g m <sup>-2</sup> - 100% DM
20-06-2012	BBCH stage 56
27-06-2012	BBCH stage 61
02-07-2012	BBCH stage 70
02-07-2012	Biomass 914.6 g m <sup>-2</sup> - 100% DM
11-07-2012	BBCH stage 73
18-07-2012	BBCH stage 77
25-07-2012	BBCH stage 83
01-08-2012	BBCH stage 86
13-08-2012	BBCH stage 89
13-08-2012	Harvest of spring barley. Stubble height 12 cm, grain yield 62.9 hkg ha <sup>-1</sup> - 85% DM.
13-08-2012	Straw shredded at harvest - 41.0 hkg ha <sup>-1</sup> - 100% DM
26-09-2012	Tracer (potassium bromide) - 30 kg ha <sup>-1</sup>
08-03-2013	Ploughed - depth 20 cm - packed with a Dalbo ring roller
05-04-2013	Fertilisation 16 P, 84 K, kg ha <sup>-1</sup>
23-04-2013	Seedbed preparation - depth 5 cm
23-04-2013	Sowing peas - cv. Alvesta - depth 5 cm, row distance 12 cm, seeding rate 230 kg ha <sup>-1</sup> . Final plant number 82 m <sup>-2</sup>
23-04-2013	Rolled with a Cambridge roller
25-04-2013	BBCH stage 00
25-04-2013	Command CS (clomazone) - weeds - 0.25 L ha <sup>-1</sup>
04-05-2013	BBCH 09 – emergence
16-05-2013	BBCH stage 12
16-05-2013	Fighter 480 (bentazone) - weeds - 1.0 L ha <sup>-1</sup>
16-05-2013	Cyperb (cypermethrin) - pests - 0.3 L ha <sup>-1</sup> (not analysed)
22-05-2013	BBCH stage 31
27-05-2013	BBCH stage 33
27-05-2013	Biomass 42.3 g m <sup>-2</sup> - 100% DM
06-06-2013	BBCH stage 37
12-06-2013	BBCH stage 40
21-06-2013	BBCH stage 60
21-06-2013	Biomass 357.7 g m <sup>-2</sup> - 100% DM
26-06-2013	BBCH stage 62

Date	Management practice and growth stages – Estrup
09-07-2013	BBCH stage 66
12-07-2013	BBCH stage 68
12-07-2013	Biomass 718.1 g m <sup>-2</sup> - 100% DM
13-07-2013	BBCH stage 68
13-07-2013	Pirimor G (pirimicarb) - pests - 0.25 kg ha <sup>-1</sup> (not analysed)
17-07-2013	BBCH stage 79
31-07-2013	BBCH stage 83
05-08-2013	BBCH stage 83
05-08-2013	Biomass 985.3 g m <sup>-2</sup> - 100% DM
13-08-2013	BBCH stage 87
20-08-2013	BBCH stage 90
21-08-2013	Glyfonova 450 Plus (glyphosate) - weeds - 2.4 L ha <sup>-1</sup>
27-08-2013	BBCH stage 93
06-09-2013	Harvest of peas. Stubble height 10 cm, seed yield 49.8 hkg ha <sup>-1</sup> - 86% dry matter.
06-09-2013	Straw shredded at harvest - 24.38 hkg ha <sup>-1</sup> 100% DM
13-09-2013	Winter wheat sown cv. Herford. Depth 4.0 cm, row distance 12 cm, seeding rate 180 kg ha <sup>-1</sup> . Final plant number 365 m <sup>-2</sup> using a combined power harrow sowing equipment
21-09-2013	BBCH 09 – emergence
25-09-2013	BBCH stage 11
09-10-2013	BBCH stage 12
14-10-2013	BBCH stage 20
14-10-2013	Fertilisation manganese nitrate (23.5%) - 2.0 kg ha <sup>-1</sup>
30-10-2013	BBCH stage 21
11-11-2013	BBCH stage 24
11-11-2013	Oxitril CM (bromoxynil + ioxynil) + DFF (diflufenican) - weeds - 0.2 L ha <sup>-1</sup> + 0.24 L ha <sup>-1</sup> (bromoxynil and ioxynil not included)
13-11-2013	BBCH stage 24
02-04-2014	BBCH stage 30
04-04-2014	BBCH stage 30
04-04-2014	Fertilisation 150 N, 16 P, 60 K, kg ha <sup>-1</sup> (liquid fertiliser - applied 1000 L ha <sup>-1</sup> with a sprayer)
22-04-2014	BBCH stage 32
22-04-2014	Fluxyr 200 EC - (fluroxypyr) - weeds - 0.7 L ha <sup>-1</sup> (not included)
22-04-2014	Fertilisation manganese nitrate (23,5%) - 2.0 kg ha <sup>-1</sup>
07-05-2014	BBCH stage 34
07-05-2014	Biomass 54.0 g m <sup>-2</sup> - 100% DM
15-05-2014	BBCH stage 36
15-05-2014	Primus (florasulam) - weeds - 50 mL ha <sup>-1</sup>
20-05-2014	BBCH stage 38
20-05-2014	Folicur 250 EC (tebuconazole) - fungi - 1.0 L ha <sup>-1</sup>
27-05-2014	BBCH stage 50
02-06-2014	BBCH stage 59
02-06-2014	Biomass 497.3 g m <sup>-2</sup> - 100% DM
02-06-2014	Amistar (azoxystrobin) - fungi - 1.0 L ha <sup>-1</sup>
11-06-2014	BBCH stage 67
18-06-2014	BBCH stage 71
24-06-2014	BBCH stage 72
24-06-2014	Cyperb (cypermethrin) - pests - 0.25 L ha <sup>-1</sup> (not included)
02-07-2014	BBCH stage 74
07-07-2014	BBCH stage 75
07-07-2014	Biomass 1557.7 g m <sup>-2</sup> - 100% DM
16-07-2014	BBCH stage 82
26-07-2014	BBCH stage 87
26-07-2014	Glyfonova 450 Plus (glyphosate) - weeds – 2.4 L ha <sup>-1</sup>
06-08-2014	BBCH stage 90
06-08-2014	Harvest of winter wheat. Stubble height 11 cm, grain yield 69.3 hkg ha <sup>-1</sup> - 85% DM
12-08-2014	Harrowed to 5 cm depth and sown a catch crop of oilseed radish 12 kg ha <sup>-1</sup> seed on soil surface
06-08-2014	Straw shredded at harvest - 48.7 hkg ha <sup>-1</sup> , 100% DM
12-08-2014	Liming 3.5 t ha <sup>-1</sup> magnesium limestone

Date	Management practice and growth stages – Estrup
29-04-2015	Pig slurry application - acidified at application from pH 7.15 to 6.82- hose applied at surface - 28.0 t ha <sup>-1</sup> - 117.3 Total-N, 76.44 NH <sub>4</sub> -N, 39.2 P, 47.9 K, kg ha <sup>-1</sup> , DM of slurry 5.43%
29-04-2015	Ploughed - depth 20 cm
11-05-2015	Seedbed preparation - depth 5 cm using a Rabewerke rotary cultivator
11-05-2015	Fertilisation 30.8 N, 4.7 P, 19.0 K, kg ha <sup>-1</sup> (placed at sowing)
11-05-2015	Sowing maize cv. Ambition, depth 4 cm, row distance 75 cm, seed distance 12.1 cm seeding rate 11 m <sup>-2</sup> . Final plant number 10.5 m <sup>-2</sup>
13-05-2015	Fertilisation 55.3 N, 8.5 P, 34.0 K, kg ha <sup>-1</sup> (applied with a field sprayer - liquid fertiliser)
27-05-2015	BBCH stage 09 - emergence
27-05-2015	Callisto (mesotrione) + Harmony SX (thifensulfuron-methyl) - weeds - (0.75 L ha <sup>-1</sup> + 5.625 g ha <sup>-1</sup> ) (75 g a.i. ha <sup>-1</sup> + 2.813 g a.i. ha <sup>-1</sup> )
03-06-2015	BBCH stage 12
06-06-2015	BBCH stage 13
06-06-2015	Callisto (mesotrione) + MaisTer (foramsulfuron + iodosulfuron) - weeds - (0.75 L ha <sup>-1</sup> + 100 g ha <sup>-1</sup> ) (75 g a.i. ha <sup>-1</sup> + 30 g a.i. ha <sup>-1</sup> + 1 g a.i. ha <sup>-1</sup> )
08-06-2015	BBCH stage 13
08-06-2015	Biomass 0.4 g m <sup>-2</sup> - 100% DM
18-06-2015	BBCH stage 14
23-06-2015	BBCH stage 16
30-06-2015	BBCH stage 18
30-06-2015	MaisTer (foramsulfuron + iodosulfuron) + Lodin 200 EC (fluroxypyr) - weeds - (50 g ha <sup>-1</sup> + 1.0 L ha <sup>-1</sup> ) (i.e. 15 g a.i. ha <sup>-1</sup> + 0.5 g a.i. ha <sup>-1</sup> + 180 g a.i. ha <sup>-1</sup> ) (fluroxypyr not included)
01-07-2015	BBCH stage 19
09-07-2015	BBCH stage 22
16-07-2015	BBCH stage 33
23-07-2015	BBCH stage 43
30-07-2015	BBCH stage 51
04-08-2015	BBCH stage 51
04-08-2015	Biomass 1794 g m <sup>-2</sup> - 100% DM
05-08-2015	BBCH stage 60
13-08-2015	BBCH stage 65
08-06-2015	Biomass 4159 g m <sup>-2</sup> - 100% DM
20-08-2015	BBCH stage 69
01-09-2015	BBCH stage 72
15-09-2015	BBCH stage 73
22-09-2015	BBCH stage 74
06-10-2015	BBCH stage 75
13-10-2015	BBCH stage 78
23-10-2015	BBCH stage 81
23-10-2015	Harvest of maize. Stubble height 25 cm. Total harvested yield 105.98 hkg ha <sup>-1</sup> 100% DM.
04-05-2016	Pig slurry application - acidified at application trail hose applied at surface - 21.0 t ha <sup>-1</sup> - 86.5 Total-N, 56.3 NH <sub>4</sub> -N, 11.6 P, 29.6 K, kg ha <sup>-1</sup> , DM of slurry 3.58 %
05-05-2016	Ploughed - depth 20 cm
06-05-2016	Seedbed preparation - depth 5 cm using a Rabewerke rotary cultivator
06-05-2016	Fertilisation 150 N, 20 P, 60 K, kg ha <sup>-1</sup> (20% thereof placed at sowing and 80% harrowed into the soil before the sowing)
06-05-2016	Sowing maize cv. Ambition, depth 4 cm, row distance 75 cm, seed distance 12.1 cm, seeding rate 11 m <sup>2</sup> . Final plant number 10.5 m <sup>2</sup>
14-05-2016	BBCH stage 09 - emergence
14-05-2016	BBCH stage 11
14-05-2016	BBCH stage 13
01-06-2016	BBCH stage 14
01-06-2016	Callisto (mesotrione) + Harmony SX (thifensulfuron-methyl) - weeds - (0.75 l ha <sup>-1</sup> + 5.625 g ha <sup>-1</sup> ) (75 g a.i. ha <sup>-1</sup> + 2.813 g a.i. ha <sup>-1</sup> )
05-06-2016	BBCH stage 14
05-06-2015	Biomass 288.5 g m <sup>-2</sup> - 100% DM
08-06-2016	BBCH stage 16
11-06-2016	BBCH stage 17

Date	Management practice and growth stages – Estrup
11-06-2016	Callisto (mesotrione) + MaisTer (foramsulfuron + iodosulfuron) - weeds - (0.75 l ha <sup>-1</sup> + 100 g ha <sup>-1</sup> ) (75 g a.i. ha <sup>-1</sup> + 30 g a.i. ha <sup>-1</sup> + 1 g a.i. ha <sup>-1</sup> )
15-06-2016	BBCH stage 18
16-06-2016	BBCH stage 18
16-06-2016	MaisTer (foramsulfuron + iodosulfuron) - weeds - (50 g ha <sup>-1</sup> ) (15 g a.i. ha <sup>-1</sup> + 0.5 g a.i. ha <sup>-1</sup> )
22-06-2016	BBCH stage 25-26
29-06-2016	BBCH stage 46-47
13-07-2016	BBCH stage 51
13-07-2016	Biomass 3069.0 g m <sup>-2</sup> - 100% DM
27-07-2016	BBCH stage 57
09-08-2016	BBCH stage 65
09-08-2016	Biomass 8118.8 g m <sup>-2</sup> - 100% DM
10-08-2016	BBCH stage 65
24-08-2016	BBCH stage 71
07-09-2016	BBCH stage 80
21-09-2016	BBCH stage 86
30-09-2016	Harvest of maize. Stubble height 43 cm. Total harvested yield 184.76 hkg ha <sup>-1</sup> 100% DM.
04-04-2017	Fertilisation 28 P, 147 K, kg ha <sup>-1</sup>
08-04-2017	Sowing peas - cv. Mascara - depth 7 cm, row distance 13 cm seeding rate 220 kg ha <sup>-1</sup> . Final plant number 72 m <sup>2</sup>
14-04-2017	BBCH stage 09 - emergence
15-04-2017	BBCH stage 12
15-04-2017	Stomp CS (pendimethalin) - weeds - 1.0 L ha <sup>-1</sup> (455 g a.i. ha <sup>-1</sup> ) - not included in monitoring
15-04-2017	Fighter 480 (bentazone) - weeds - 1.0 L ha <sup>-1</sup> (480 g a.i. ha <sup>-1</sup> )
08-05-2017	BBCH stage 12
15-05-2017	BBCH stage 32
22-05-2017	BBCH stage 35
22-05-2017	Biomass 26.7 g m <sup>-2</sup> - 100% DM
08-06-2017	BBCH stage 51
12-06-2017	BBCH stage 60
12-06-2017	Biomass 162.8 g m <sup>-2</sup> - 100% DM
22-06-2017	BBCH stage 62
29-06-2017	BBCH stage 64
07-07-2017	BBCH stage 65
10-07-2017	BBCH stage 70
10-07-2017	Biomass 484.4 g m <sup>-2</sup> - 100% DM
19-07-2017	BBCH stage 70
04-08-2017	BBCH stage 82
04-08-2017	Biomass 613.2 g m <sup>-2</sup> - 100% DM
07-08-2017	BBCH stage 090
07-08-2017	Glyphomax HL (glyphosate) - weeds - 2.5 L ha <sup>-1</sup> (1152 g a.i. ha <sup>-1</sup> )
10-08-2017	BBCH stage 090
15-08-2017	Harvest of peas. Stubble height 10 cm, seed yield 24.2 hkg ha <sup>-1</sup> - 86% dry matter.
15-08-2017	Straw shredded at harvest - 18.85 hkg ha <sup>-1</sup> -100 % DM
22-09-2017	Ploughed - depth 20 cm
22-09-2017	Winter wheat sown cv. Sheriff, depth 4.0 cm row distance 12 cm seeding rate 168 kg ha <sup>-1</sup> . Final plant number 320 m <sup>2</sup> using a combined power harrow sowing equipment
22-09-2017	Seed dressing Redigo Pro 170 FS (12.6 g prothioconazole a.i. ha <sup>-1</sup> and 1.68 g a.i. ha <sup>-1</sup> )
05-10-2017	BBCH stage 09 - emergence
16-10-2017	BBCH stage 12
16-10-2017	Lexus 50 WG (flupyr-sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.63 g a.i. ha <sup>-1</sup> flupyr-sulfuron)
27-03-2018	BBCH stage 20
03-04-2018	BBCH stage 21
06-04-2018	BBCH stage 24
06-04-2018	Fertilisation 52.0 N kg ha <sup>-1</sup>
18-04-2018	BBCH stage 25
18-04-2018	Biomass 60.1 g m <sup>-2</sup> - 100% DM
20-04-2018	BBCH stage 28

Date	Management practice and growth stages – Estrup
20-04-2018	Hussar Plus OD - weeds - 0.14 L ha <sup>-1</sup> (7.0 g a.i. ha <sup>-1</sup> iodosulfuron-methyl-Na and 1.05 g a.i. ha <sup>-1</sup> mesosulfuron-methyl)
30-04-2018	BBCH stage 30
30-04-2018	Pig slurry application (sow) - trail hose applied at surface - 41.7 t ha <sup>-1</sup> - 93.4 Total-N, 78.8 NH <sub>4</sub> -N, 5.4 P, 135.5 K, kg ha <sup>-1</sup> , DM of slurry 1.0 %
03-05-2018	BBCH stage 31
03-05-2018	Lexus 50 WG (flupyr-sulfuron) - weeds - 10 g ha <sup>-1</sup> (4.63 g a.i. ha <sup>-1</sup> flupyr-sulfuron)
14-05-2018	BBCH stage 41
24-05-2018	BBCH stage 50
30-05-2018	BBCH stage 52
30-05-2018	Biomass 2581.7 g m <sup>-2</sup> - 100% DM
04-06-2018	BBCH stage 68-69
06-06-2018	BBCH stage 68-69
06-06-2018	Topsin WG (thiophanate-methyl) - fungi - 1.1 kg ha <sup>-1</sup> (770 g a.i. ha <sup>-1</sup> )
13-05-2018	BBCH stage 71
21-06-2018	BBCH stage 73
21-06-2018	Karate 2.5 WG (lambda-cyhalothrin - (pests) - 0.2 kg ha <sup>-1</sup> (10 g a.i. ha <sup>-1</sup> ) (not monitored)
22-06-2018	BBCH stage 73
09-07-2018	BBCH stage 75
10-07-2018	BBCH stage 75
10-07-2018	Biomass 2836.3 g m <sup>-2</sup> - 100% DM
17-07-2018	BBCH stage 80
25-07-2018	BBCH stage 89
27-07-2018	Harvest of winter wheat. Stubble height 13 cm, grain yield 75.2 hkg ha <sup>-1</sup> - 85% DM,
27-07-2018	Straw shredded at harvest - 37.9 hkg ha <sup>-1</sup> 100% DM
05-11-2018	Ploughed - depth 20 cm
08-04-2019	Fertilisation 137 N, 26 P, 65 K, kg ha <sup>-1</sup>
08-04-2019	Spring barley sown cv. Flair. Depth 4 cm, seeding rate 165 kg ha <sup>-1</sup> , row distance 12.0 cm. Final plant number 360 m <sup>-2</sup> . Sown with combine seed drill (Amazone Drill-Star RP-AD 302)
08-04-2019	Redigo Pro 170 FS (12.38 g a.i. ha <sup>-1</sup> prothioconazole + 1.65 g a.i. ha <sup>-1</sup> tebuconazole) - seed dressing
17-04-2019	BBCH stage 09 - emergence
02-05-2019	BBCH stage 17
15-05-2019	BBCH stage 23
15-05-2019	Biomass 194.9 g m <sup>-2</sup> - 100% DM
22-05-2019	BBCH stage 31
22-05-2019	Pixxaro EC (fluroxypyr + halauxifen-methyl) - weeds - 0.35 L ha <sup>-1</sup> (98 g a.i. ha <sup>-1</sup> fluroxypyr and 4.375 g a.i. ha <sup>-1</sup> halauxifen-methyl)
22-05-2019	Juventus 90 (metconazole) - fungi - 1.0 L ha <sup>-1</sup> (90 g metconazole a.i. ha <sup>-1</sup> )
05-06-2019	BBCH stage 41
12-06-2019	BBCH stage 50
12-06-2019	Biomass 420.8 g m <sup>-2</sup> - 100% DM
13-06-2019	BBCH stage 50
13-06-2019	Juventus 90 (metconazole) - fungi - 1.0 L ha <sup>-1</sup> (90 g metconazole a.i. ha <sup>-1</sup> )
26-06-2019	BBCH stage 62
09-07-2019	BBCH stage 75
09-07-2019	Biomass 1096.2 g m <sup>-2</sup> - 100% DM
25-07-2019	BBCH stage 83
01-08-2019	BBCH stage 87
08-08-2019	BBCH stage 89
11-08-2019	Harvest of spring barley. Stubble height 20 cm, grain yield 70.4 hkg ha <sup>-1</sup> 85% DM, straw yield 23.3 hkg ha <sup>-1</sup> 100% DM
11-08-2019	Straw shredded at harvest - 23.3 hkg ha <sup>-1</sup> 100% DM
16-09-2019	Ploughed - depth 20 cm
16-09-2019	Winter wheat sown cv. Sheriff. Depth 4.0 cm row distance 12 cm, seeding rate 178 kg ha <sup>-1</sup> , final plant number 360 g m <sup>-2</sup> using a combined power harrow sowing equipment
16-09-2019	Redigo Pro 170 FS 89 ml ha <sup>-1</sup> (13.35 g a.i. ha <sup>-1</sup> prothioconazole + 1.78g a.i. ha <sup>-1</sup> tebuconazole) - seed dressing
26-09-2019	BBCH stage 09 – emergence
07-10-2019	BBCH stage 21

Date	Management practice and growth stages – Estrup
07-10-2019	Stomp CS (pendimethalin) - weeds - 1.0 L ha <sup>-1</sup> (455 g a.i. ha <sup>-1</sup> ) (not monitored)
07-04-2020	BBCH stage 21
07-04-2020	Fertilisation 136.5 N, 26 P, 65 K, kg ha <sup>-1</sup>
15-04-2020	BBCH stage 22
15-04-2020	Fertilisation 73.5 N, 14P, 35 K, kg ha <sup>-1</sup>
21-04-2020	BBCH stage 22
21-04-2020	Biomass 27.3 g m <sup>-2</sup> - 100% DM
03-05-2020	BBCH stage 31
03-05-2020	Broadway (pyroxsulam + florasulam) - weeds - 165 g ha <sup>-1</sup> (11.27 g a.i. ha <sup>-1</sup> pyroxsulam and 3.76 g a.i. ha <sup>-1</sup> florasulam)
14-05-2020	BBCH stage 35
24-05-2020	BBCH stage 41
29-05-2020	BBCH stage 49
29-05-2020	Biomass 450 g m <sup>-2</sup> - 100% DM
15-06-2020	BBCH stage 52
26-06-2020	BBCH stage 65
08-07-2020	BBCH stage 75
08-07-2020	Biomass 1298.3 g m <sup>-2</sup> - 100% DM
22-07-2020	BBCH stage 79
03-08-2020	BBCH stage 87
11-08-2020	BBCH stage 91
11-08-2020	Harvest of winter wheat. Stubbleheight 15 cm, grain yield 71.4 hkg ha <sup>-1</sup> - 85% DM. Straw yield 38.4 hkg ha <sup>-1</sup> - fresh weight, shredded at harvest
02-02-2021	Liming 3.5 t ha <sup>-1</sup> magnesium limestone
19-04-2021	Spring barley sown cv. Flair, sowing depth 4.0 cm, rowdistance 12 cm, seeding rate 230 kg ha <sup>-1</sup> , final plantnumber 385 m <sup>-2</sup> using combined powerharrow sowing equipment
19-04-2021	Redigo Pro 170 FS 115 mL ha <sup>-1</sup> (17.3 g a.i. ha <sup>-1</sup> prothioconazole and 2.3 g a.i. ha <sup>-1</sup> tebuconazole) - seed dressing
21-04-2021	BBCH stage 00
21-04-2021	Fertilisation 120.0 N, 22.8 P, 57.0 K, kg ha <sup>-1</sup>
27-04-2021	BBCH stage 11 - emergence
12-05-2021	BBCH stage 22
21-05-2021	BBCH stage 25
01-06-2021	BBCH stage 27
01-06-2021	Biomass 56.1 g m <sup>-2</sup> - 100% DM
01-06-2021	Harmony 50 SX (thifensulfuron-methyl) - weeds - 18 g ha <sup>-1</sup> (9 g a.i. ha <sup>-1</sup> ) - monitored
16-06-2021	BBCH stage 47
16-06-2021	Biomass 333.0 g m <sup>-2</sup> - 100% DM
24-06-2021	BBCH stage 61
08-07-2021	BBCH stage 75
08-07-2021	Biomass 1053.7 g m <sup>-2</sup> - 100% DM
22-07-2021	BBCH stage 78
06-08-2021	BBCH stage 83
15-08-2021	BBCH stage 89
15-08-2021	Harvest of spring barley. Grain yield 44.6 hkg ha <sup>-1</sup> - 85% DM. Straw yield 29.0 hkg ha <sup>-1</sup> - 100% DM, stubbleheight 12 cm. Straw shredded (left in field) at harvest
23-08-2021	Grass sown, mixture of perennial ryegrass varieties: Foragemax33. Depth 2.0 cm, rowdistance 12 cm, seeding rate 29.5 kg ha <sup>-1</sup>
01-09-2021	BBCH stage 09 - emergence
01-04-2022	Fertilisation 63.0 N, 12.0 P, 30.0 K, kg ha <sup>-1</sup>
31-05-2022	BBCH stage 55
31-05-2022	Harvest of grass. Yield 26.7 hkg ha <sup>-1</sup> - 100% DM
02-06-2022	Fertilisation 63.0 N, 12.0 P, 30.0 K, kg ha <sup>-1</sup>

**Table A3.2.** Management practice at **Faardrup** during 2012 to 2022 growing seasons. The active ingredients of the various pesticides are indicated in parentheses.

Date	Management practice and growth stages – <b>Faardrup</b>
26-03-2012	Fertilisation 112 N, 9 P, 30 K, kg ha <sup>-1</sup>
04-04-2012	Seed bed preparation - depth 7 cm
04-04-2012	Sowing spring barley using a mixture of varieties. Depth 3-4 cm, row distance 13 cm, seeding rate 98 kg ha <sup>-1</sup> . Final plant number 200 m <sup>-2</sup> . Under sown white clover cv. Liflex, seeding rate 2.0 kg ha <sup>-1</sup> , depth 2-3 cm, row distance 13 cm
04-04-2012	Tracer (potassium bromide) 30 kg ha <sup>-1</sup>
19-04-2012	BBCH stage 09 - emergence of spring barley
23-04-2012	BBCH stage 10
24-04-2012	BBCH stage 09 - emergence of white clover
03-05-2012	BBCH stage 13-21
16-05-2012	BBCH stage 23-27
18-05-2012	BBCH stage 24-29
18-05-2012	Fighter 480 (bentazone) - weeds - 1.25 L ha <sup>-1</sup>
23-05-2012	BBCH stage 29-31
23-05-2012	Biomass 112.7 g m <sup>-2</sup> - 100% DM
01-06-2012	BBCH stage 33-37
06-06-2012	BBCH stage 39
06-06-2012	Flexity (metrafenone) - fungi - 0.5 L ha <sup>-1</sup>
11-06-2012	BBCH stage 45-51
11-06-2012	Biomass 592.5 g m <sup>-2</sup> - 100% DM
21-06-2012	BBCH stage 55-57
05-07-2012	BBCH stage 71
23-07-2012	BBCH stage 83
23-07-2012	Biomass 1321.7 g m <sup>-2</sup> - 100% DM
30-07-2012	BBCH stage 85
12-08-2012	Harvest of spring barley stubble height 15 cm. Grain yield 67.51 hkg ha <sup>-1</sup> - 85% DM
12-08-2012	Straw removed. Straw yield 27.62 hkg ha <sup>-1</sup> - 100% DM
27-08-2012	BBCH stage 22-29 clover vegetative growth - formation of side shots
29-08-2012	Trimming of stubble
26-01-2013	Kerb 400 SC (propryzamide) - fungi - 1.0 L ha <sup>-1</sup>
13-05-2013	Biomass 298.2 g m <sup>-2</sup> - 100% DM
14-05-2013	Fighter 480 (bentazone) - weeds - 3.0 L ha <sup>-1</sup>
22-05-2013	Rolled with a concrete roller
29-05-2013	Biomass 402.9 g m <sup>-2</sup> - 100% DM
31-05-2013	Karate (Lambda-cyhalothrin) - pest - 0.3 L ha <sup>-1</sup> (not monitored)
12-06-2013	Karate (Lambda-cyhalothrin) - pest - 0.3 L ha <sup>-1</sup> (not monitored)
25-06-2013	Biomass 698.3 g m <sup>-2</sup> - 100% DM
22-07-2013	Windrowing. Stubble height 8.0 cm
28-07-2013	Threshing of white clover. Seed yield fresh 1,560 hkg ha <sup>-1</sup> . Straw yield fresh 0.96 hkg ha <sup>-1</sup>
07-10-2013	Ploughed and packed - depth 14 cm
07-10-2013	Rotor harrowed at the time of sowing the winter wheat, cv. Mariboss - depth 4 cm, row distance 11 cm, seeding rate 200 kg ha <sup>-1</sup> - final plant number 320 m <sup>-2</sup>
18-10-2013	BBCH stage 09 – emergence
13-03-2014	BBCH stage 23
13-03-2014	Fertilisation 81 N, 16 P, 61 K, kg ha <sup>-1</sup>
09-04-2014	Fertilisation 81 N, 16 P, 61 K, kg ha <sup>-1</sup>
09-04-2014	BBCH stage 25
15-04-2014	BBCH stage 24
28-04-2014	Briotril (ioxynil + bromoxynil) - weeds - 0.6 L ha <sup>-1</sup> + Tomahawk 180 EC (fluroxypyr) - weeds - 0.8 L ha <sup>-1</sup> (neither monitored)
28-04-2014	BBCH stage 24
30-04-2014	BBCH stage 30
15-05-2014	BBCH stage 32
15-05-2014	Amistar (azoxystrobin) - fungi - 1.0 L ha <sup>-1</sup> (not monitored)
04-06-2014	Biomass 1321 g m <sup>-2</sup> - 100% DM
04-06-2014	BBCH stage 55

Date	Management practice and growth stages – Faardrup
12-06-2014	BBCH stage 59
20-07-2014	BBCH stage 83
20-07-2014	Biomass 1995 g m <sup>-2</sup> - 100% DM
25-07-2014	BBCH stage 87
30-07-2014	Harvest of winter wheat. Grain yield 56.6 hkg - 85% DM. Stubble height 12 cm
26-08-2014	Glyfonova Plus (glyphosate) - weeds - 4.0 L ha <sup>-1</sup> (not monitored)
23-09-2014	Ploughing - 14 cm depth - straw 70 hkg ha <sup>-1</sup> (fresh weight) incorporated
23-09-2014	Sowing winter wheat cv. Mariboss. Depth 3.5 cm, seeding rate 180 kg ha <sup>-1</sup> , row distance 13.0 cm. Final plant number 375 m <sup>-2</sup>
01-10-2014	BBCH stage 09 – emergence
20-11-2014	BBCH stage 23
20-11-2014	Folicur 250 (tebuconazole) - fungi - 1.0 L ha <sup>-1</sup> (250g a.i. ha <sup>-1</sup> )
30-11-2014	BBCH stage 23
30-11-2014	Lexus 50 WG (flupyrulfuron) - weeds - 10 g ha <sup>-1</sup> (4.6 g a.i. ha <sup>-1</sup> )
30-11-2014	Boxer (prosulfocarb) - weeds - 3.0 L ha <sup>-1</sup> (2400 g a.i. ha <sup>-1</sup> ) (not monitored)
10-03-2015	BBCH stage 25
10-03-2015	Biomass 44 g m <sup>-2</sup> - 100% DM
13-03-2015	BBCH stage 25
13-03-2015	Fertilisation 80 N, 18 P, 63 K, kg ha <sup>-1</sup>
21-04-2015	BBCH stage 30
21-04-2015	Fertilisation 94 N, 21 P, 74 K, kg ha <sup>-1</sup>
22-04-2015	BBCH stage 30
22-04-2015	Lexus 50 WG (flupyrulfuron) - weeds - 10 g ha <sup>-1</sup> (4.6 g a.i. ha <sup>-1</sup> )
08-05-2015	BBCH stage 37
12-05-2015	BBCH stage 37
12-05-2015	Starane XL (fluroxypyr+ florasulam) - weeds - 1.2 L ha <sup>-1</sup> (120 g a.i. ha <sup>-1</sup> + 3 g a.i. ha <sup>-1</sup> ) (florasulam not monitored)
12-05-2015	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> ) (not monitored)
12-06-2015	BBCH stage 53
23-06-2015	BBCH stage 55
23-06-2015	Biomass 356.5 g m <sup>-2</sup> - 100% DM
12-08-2015	BBCH stage 55
12-08-2015	Biomass 443.7 g m <sup>-2</sup> – 100 % DM
28-08-2015	BBCH stage 89
02-09-2015	Harvest of winter wheat. Grain yield 79.7 hkg ha <sup>-1</sup> 85% DM, straw yield 71.5 hkg ha <sup>-1</sup> 100% DM, stubble height 15 cm. Straw shredded (left in field) at harvest.
11-04-2016	Rotor harrowed at the time of sowing the spring barley. Mixture of varieties. Depth 4 cm, seeding rate 155 kg ha <sup>-1</sup> , row distance 12.0 cm. Final plant number 315 m <sup>-2</sup>
11-04-2016	Fertilisation 130 N, 26 P, 98 K, kg ha <sup>-1</sup>
20-04-2016	BBCH stage 09 – emergence
02-05-2016	BBCH stage 15
13-05-2016	BBCH stage 16-21
13-05-2016	Biomass 60.7 g m <sup>-2</sup> – 100% DM
27-05-2016	BBCH stage 27
27-05-2016	Starane 180 S + Oxitril (fluroxypyr + bromoxynil and ioxynil) - weeds - 0.8 L ha <sup>-1</sup> + 0.2 L ha <sup>-1</sup> (144 + 48 + 32 g a.i. ha <sup>-1</sup> – (bromoxynil and ioxynil not monitored)
01-06-2016	BBCH stage 31
08-06-2016	BBCH stage 39
16-06-2016	BBCH stage 47
16-06-2016	Bumper 25 EC (propiconazole) - fungi - 0.5 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> )
28-06-2016	BBCH stage 65
04-07-2016	BBCH stage 69
22-07-2016	BBCH stage 71
22-07-2016	Biomass 391.2 g m <sup>-2</sup> - 100% DM
11-08-2016	BBCH stage 87
11-08-2016	Roundup PowerMax (glyphosate) - weeds - 2.0 kg ha <sup>-1</sup> (1440 g a.i. ha <sup>-1</sup> - not monitored)
22-08-2016	BBCH stage 87
26-08-2016	Harvest of spring barley. Grain yield 57.7 hkg ha <sup>-1</sup> - 85% DM – stubble height 13 cm

Date	Management practice and growth stages – Faardrup
26-08-2016	Biomass 369.3 g m <sup>-2</sup> - 100% DM
27-08-2016	Straw removed from the field - yield 54.0 hkg ha <sup>-1</sup> fresh weight.
20-12-2016	Ploughing - depth 24 cm
07-04-2017	Fertilisation 132 N, 17 P, 61 K, kg ha <sup>-1</sup>
02-05-2017	Rotor harrowed at the time of sowing the spring barley. CV Quench. Depth 4 cm, seeding rate 180 kg ha <sup>-1</sup> , row distance 13.0 cm. Final plant number 365 m <sup>-2</sup> . Seed coated with Fungazil A (imazalil - not monitored)
10-05-2017	BBCH stage 09 - emergence
11-05-2017	BBCH stage 10-11
18-05-2017	BBCH stage 12-13
02-06-2017	BBCH stage 22
02-06-2017	Hussar Plus OD (iodosulfuron-methyl-Na and mesosulfuron -methyl) - weeds - 0.035 L ha <sup>-1</sup> (1.75 g a.i. ha <sup>-1</sup> iodosulfuron-methyl-Na and 0.27 g a.i. ha <sup>-1</sup> mesosulfuron-methyl) (not monitored)
14-06-2017	BBCH stage 43
19-06-2017	BBCH stage 45
19-06-2017	Biomass 115.8 g m <sup>-2</sup> - 100% DM
19-06-2017	Bumper 25 EC (propiconazole) - fungi - 0.5 L ha <sup>-1</sup> (i.e. 125 g a.i. ha <sup>-1</sup> )
19-06-2017	Zypar (halauxifen-methyl + florasulam) - weeds - 0.5 L ha <sup>-1</sup> (i.e. 3.125 g a.i. ha <sup>-1</sup> halauxifen-methyl and 2.5 g a.i. ha <sup>-1</sup> florasulam)
07-07-2017	BBCH stage 65
07-07-2017	Bumper 25 EC (propiconazole) - fungi - 0.5 L ha <sup>-1</sup> (i.e. 125 g a.i. ha <sup>-1</sup> )
15-08-2017	BBCH stage 85
15-08-2017	Biomass 317.2 g m <sup>-2</sup> - 100% DM
22-08-2017	Harvest of spring barley. Grain yield 62.3 hkg ha <sup>-1</sup> fresh weight and 35.5 hkg ha <sup>-1</sup> straw fresh weight – stubble height 9 cm
20-10-2017	Glyphomax (glyphosate) - weeds - 2.5 L ha <sup>-1</sup> (900 g a.i. ha <sup>-1</sup> ) (not monitored)
03-12-2017	Ploughing - depth 22 cm
20-04-2018	Seed bed preparation - depth 10 cm
20-04-2018	Sowing sugar beet cv. SMART JANNINKA KWS. depth 2.0 cm row distance 50.0 cm plant distance 25cm. seeding rate 100.000 seeds ha <sup>-1</sup> , seed bed rather uneven, Final plant number 9 m <sup>-2</sup>
20-04-2018	Seed dressing Gaucho WS70 (60 g a.i. ha <sup>-1</sup> imidacloprid) and Tachigaren WP (14-18 g a.i. ha <sup>-1</sup> hymexazol) (not monitored). Fertilisation 140 N, 24.5 P, 65.3 K, kg ha <sup>-1</sup> , done together with sowing
20-04-2018	BBCH stage 09 – emergence
07-05-2018	BBCH stage 11
18-05-2018	BBCH stage 11
22-05-2018	BBCH stage 12
25-05-2018	BBCH stage 12
29-05-2018	2.0 L ha <sup>-1</sup> Betanal (phenmedipham) - weeds (320 g a.i. ha <sup>-1</sup> phenmedipham) (not monitored)
29-05-2018	1.0 L ha <sup>-1</sup> Goltix (metamitron) - weeds (i.e. 700 g a.i. ha <sup>-1</sup> )
	0.16 L ha <sup>-1</sup> Conviso One (foramsulfuron + thienkarbazone-methyl) - weeds (4.8 g a.i. ha <sup>-1</sup> foramsulfuron and 8.0 g a.i. ha <sup>-1</sup> thienkarbazone-methyl)
	0.07 L ha <sup>-1</sup> Nortron SC (ethofumesat) - weeds (35 g a.i. ha <sup>-1</sup> ) (not monitored)
08-06-2018	BBCH stage 15
08-06-2018	Mechanical weeding between rows - depth 3 cm
12-06-2018	BBCH stage 15
12-06-2018	2.0 L ha <sup>-1</sup> Betanal (phenmedipham) - weeds (320 g a.i. ha <sup>-1</sup> phenmedipham) (not monitored)
	1.0 L ha <sup>-1</sup> Goltix (metamitron) - weeds (700 g a.i. ha <sup>-1</sup> )
	0.07 L ha <sup>-1</sup> Nortron SC (ethofumesat) - weeds (35 g a.i. ha <sup>-1</sup> ) (not monitored)
27-06-2018	BBCH stage 15
27-06-2018	2.0 L ha <sup>-1</sup> Betanal (phenmedipham) - weeds (320 g a.i. ha <sup>-1</sup> phenmedipham) (not monitored)
	1.0 L ha <sup>-1</sup> Goltix (metamitron) - weeds (700 g a.i. ha <sup>-1</sup> )
	0.07 L ha <sup>-1</sup> Nortron SC (ethofumesat) - weeds (35 g a.i. ha <sup>-1</sup> ) (not monitored)
	0.2 kg ha <sup>-1</sup> Karate 2,5 WG (lambda-cyhalothrin) - pests (10 g a.i. ha <sup>-1</sup> ) (not monitored)
01-07-2018	BBCH stage 15
09-07-2018	BBCH stage 19
09-07-2018	Biomass 1248.1 g m <sup>-2</sup> – sugar beet top only - 100% DM
28-09-2018	BBCH stage 49
28-09-2018	Harvest of sugar beets 79.8 hkg ha <sup>-1</sup> root - 100% DM Top 32.0 hkg ha <sup>-1</sup> - 100% DM
18-12-2018	Ploughing - depth 22 cm

Date	Management practice and growth stages – Faardrup
05-04-2019	Seed bed preparation, depth 3 cm
08-04-2019	Sowing spring barley cv. IKWS Irina - seed coated with Redigo Pro. Depth 3 cm, seeding rate 170 kg ha <sup>-1</sup> , row distance 12.5 cm. Final plant number 365 m <sup>-2</sup>
08-04-2019	Redigo Pro 170 FS (12.75 g a.i. ha <sup>-1</sup> prothioconazole + 1.70 g a.i. ha <sup>-1</sup> tebuconazole) - seed dressing
09-04-2019	Fertilisation 113. 3 N, 19.8 P, 52.8 K, kg ha <sup>-1</sup>
11-04-2019	Rolled with a ring roller
15-04-2019	BBCH stage 09 - emergence
23-04-2019	BBCH stage 10
26-04-2019	BBCH stage 12
26-04-2019	DFP (diflufenican) - weeds - 0.15 L ha <sup>-1</sup> (75 g a.i. ha <sup>-1</sup> ) (not monitored)
29-04-2019	BBCH stage 20
15-05-2019	BBCH stage 20
15-05-2019	Biomass 50.1 g m <sup>-2</sup> - 100% DM
03-06-2019	BBCH stage 32
03-06-2019	Talius (proquinazid) - fungi - 0.125 L ha <sup>-1</sup> (25 g a.i. ha <sup>-1</sup> )
17-06-2019	BBCH stage 45
17-06-2019	Talius (proquinazid) - fungi - 0.125 L ha <sup>-1</sup> (25 g a.i. ha <sup>-1</sup> )
01-07-2019	BBCH stage 51
01-07-2019	Biomass 341.9 g m <sup>-2</sup> - 100% DM
18-07-2019	BBCH stage 75
18-07-2019	Biomass 1188.9 g m <sup>-2</sup> - 100% DM
12-08-2019	BBCH stage 89
12-08-2019	Harvest of spring barley. Grain yield 82.0 hkg ha <sup>-1</sup> - 85% DM – stubble height 13 cm. Straw yield 35.5 hkg ha <sup>-1</sup> (DM not measured)
15-11-2019	Ploughing, depth 24 cm
20-03-2020	Seed bed preparation - depth 4.0 cm
26-03-2020	Sowing spring wheat cv. Cornette - seed coated with Celest Formula M (fludioxonil). Sowing depth 4 cm, seeding rate 200 kg ha <sup>-1</sup> , row distance 12.0 cm. Final plant number 364 m <sup>-2</sup>
02-04-2020	Fertilisation 134.0 N, 26.0 P, 65.0 K, kg ha <sup>-1</sup>
06-04-2020	BBCH stage 09 - emergence
15-04-2020	BBCH stage 10-12
16-04-2020	Rolled with a ring roller
04-05-2020	BBCH stage 20
12-05-2020	BBCH stage 20
12-05-2020	Biomass 72.7 g m <sup>-2</sup> - 100% DM
20-05-2020	BBCH stage 30
20-05-2020	Buctril EC 225 (bromoxynil) - weeds – 0.4 L ha <sup>-1</sup> (90 g a.i. ha <sup>-1</sup> ) (not monitored)
12-06-2020	BBCH stage 51
13-08-2020	BBCH stage 83
14-08-2020	Harvest of spring wheat. Grain yield 56.5 hkg ha <sup>-1</sup> - 85% DM. Straw yield 43.1 hkg ha <sup>-1</sup> - 100% DM, stubbleheight 10 cm - shredded at harvest
14-08-2020	Ploughing, depth 23 cm
29-08-2020	Sowing winter rapeseed cv. V3160L c. Sowing depth 2 cm, seeding rate 2 kg ha <sup>-1</sup> , row distance 13 cm
29-08-2020	Integral Pro ( <i>Bacillus amyloliquefaciens</i> MBI 600) - seed dressing
01-09-2020	BBCH stage 0
01-09-2020	Kalif 360 CS (clomazon) - weeds - 0.25 L ha <sup>-1</sup> (90 g a.i. ha <sup>-1</sup> ) - not monitored
03-09-2020	BBCH stage 09 - emergence
25-11-2020	BBCH stage 15
25-11-2020	Kerb 400 SC (propyzamid) - weeds - 1.25 L ha <sup>-1</sup> (500 g a.i. ha <sup>-1</sup> ) - monitored
09-03-2021	BBCH stage 19
09-03-2021	Fertilisation 123.6 N, 21.6 P, 60.0 K, kg ha <sup>-1</sup>
07-04-2021	BBCH stage 19
07-04-2021	Biomass 104.5 g m <sup>-2</sup> - 100% DM
13-04-2021	Fertilisation 97.9 N, 3.5 P, 47.5 K, kg ha <sup>-1</sup>
28-04-2021	BBCH stage 33
28-04-2021	Biomass 245.4 g m <sup>-2</sup> - 100% DM
11-05-2021	BBCH stage 55
12-05-2021	Biomass 440.3 g m <sup>-2</sup> - 100% DM

Date	Management practice and growth stages – Faardrup
26-05-2021	BBCH stage 69
26-05-2021	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 1 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> prothioconazole and 125 g a.i. ha <sup>-1</sup> fluopyram) - monitored
11-08-2021	Harvest of rapeseed. Seed yield 29.6 hkg ha <sup>-1</sup> - fresh weight. Stubbleheight 20 cm, shredded at harvest
28-09-2021	Glyphomax HL (glyphosate) - weeds - 2.25 L ha <sup>-1</sup> (1080 g a.i. ha <sup>-1</sup> ) - not monitored
07-10-2021	Ploughing, depth 24 cm
08-10-2021	Sowing winter wheat cv. Rembrandt, sowing depth 3 cm, seeding rate 200 kg ha <sup>-1</sup> , row distance 12 cm. Final plant number 320 m <sup>-2</sup>
08-10-2021	Redigo Pro 170 FS 100 mL ha <sup>-1</sup> (15 g a.i. ha <sup>-1</sup> prothioconazole and 2 g a.i. ha <sup>-1</sup> tebuconazol) - seed dressing
22-10-2021	BBCH stage 09 - emergence
26-10-2021	BBCH stage 10
24-01-2022	BBCH stage 15
09-03-2022	BBCH stage 15-20
09-03-2022	Fertilisation 98.7 N, 18.8 P, 47.0 K, kg ha <sup>-1</sup>
22-03-2022	BBCH stage 23
22-03-2022	Biomass 27.3 g m <sup>-2</sup> - 100% DM
06-04-2022	BBCH stage 28
21-04-2022	Express Gold 33 SX (tribenuron-methyl and metsulfuron-methyl) - weeds - 18 g ha <sup>-1</sup> (4 g a.i. ha <sup>-1</sup> tribenuron-methyl and 2 g a.i. ha <sup>-1</sup> metsulfuron-methyl) - monitored
27-04-2022	BBCH stage 30
27-04-2022	Fertilisation 57.8 N, 11.0 P, 27.5 K, kg ha <sup>-1</sup>
02-05-2022	BBCH stage 31
04-05-2022	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 0.5 L ha <sup>-1</sup> (62.5 g a.i. ha <sup>-1</sup> prothioconazole and 62.5 g a.i. ha <sup>-1</sup> fluopyram) - monitored
18-05-2022	BBCH stage 37
23-05-2022	BBCH stage 41
30-05-2022	BBCH stage 51
30-05-2022	Biomass 967.6 g m <sup>-2</sup> - 100% DM
30-05-2022	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 0.5 L ha <sup>-1</sup> (62.5 g a.i. ha <sup>-1</sup> prothioconazole and 62.5 g a.i. ha <sup>-1</sup> fluopyram) - monitored
14-06-2022	BBCH stage 66
23-06-2022	BBCH stage 71
30-06-2022	BBCH stage 75
30-06-2022	Biomass 1927.9 g m <sup>-2</sup> - 100% DM

**Table A3.2.** Management practice at **Lund** during 2012 to 2022 growing seasons. The active ingredients of the various pesticides are indicated in parentheses.

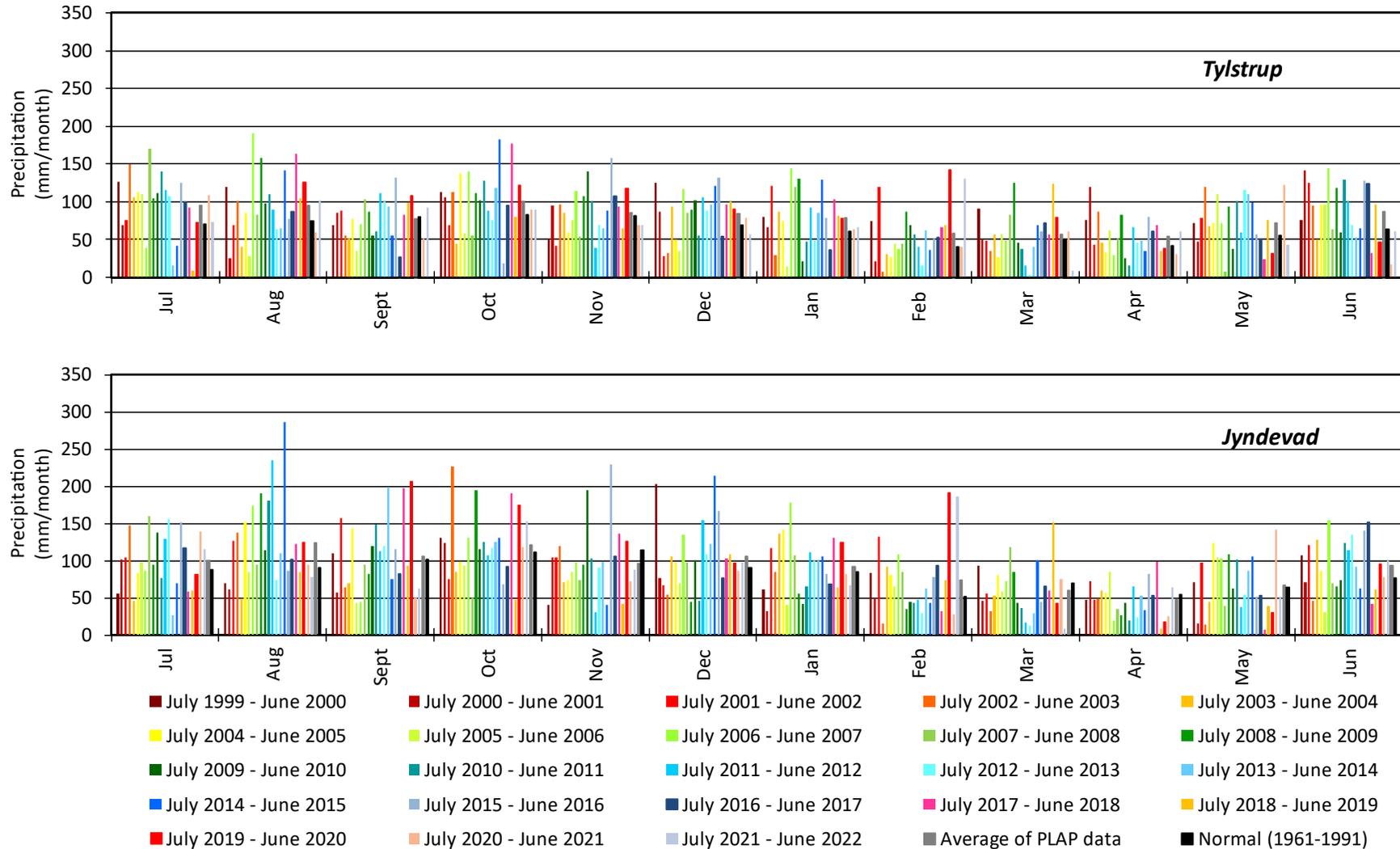
Date	Management practice and growth stages – Lund
22-03-2017	Ploughing - 25 cm depth
02-04-2017	Fertilisation 123.6 N, 15.6 P, 57.6 K, kg ha <sup>-1</sup>
03-04-2017	Seed bed preparation - 8 cm depth
03-04-2017	Sowing spring barley cv. Irina. Depth 3.5 cm, seeding rate 175 kg ha <sup>-1</sup> , row distance 12 cm, final plant number 245 m <sup>-2</sup>
03-04-2017	Seed dressing Fungazil A (imazalil 87.5 g a.i. ha <sup>-1</sup> ) (not monitored)
03-04-2017	Clover grass sown (white clover and smooth meadow-grass). Depth 1.5 cm, seeding rate 28 kg ha <sup>-1</sup>
20-04-2017	BBCH stage 09 - emergence
08-05-2017	BBCH stage 12 to 14
09-05-2017	BBCH stage 20
09-05-2017	Fighter 480 (bentazone) - weeds - 1.5 L ha <sup>-1</sup> (720 g a.i. ha <sup>-1</sup> )
09-05-2017	Stomp CS (pendimethalin) - weeds - 0.9 L ha <sup>-1</sup> (410 g a.i. ha <sup>-1</sup> ) (not monitored)
17-05-2017	BBCH stage 22
17-05-2017	Biomass 14.6 g m <sup>-2</sup> - 100% DM
07-06-2017	BBCH stage 39
15-06-2017	BBCH stage 51
15-06-2017	Amistar (azoxystrobin) - fungi - 1.0 L ha <sup>-1</sup> (250 g a.i. ha <sup>-1</sup> )
04-07-2017	BBCH stage 59
04-07-2017	Biomass 329.9 g m <sup>-2</sup> - 100% DM
11-08-2017	BBCH stage 85
11-08-2017	Biomass 359 g m <sup>-2</sup> - 100% DM
13-08-2017	Harvest of spring barley. Grain yield 71.0 hkg ha <sup>-1</sup> 85% DM, straw yield 85.2 hkg ha <sup>-1</sup> fresh weight, stubble height 8 cm
06-10-2017	Biomass 54.5 g m <sup>-2</sup> - 100% DM (catch crop of clover and grass)
19-10-2017	Glyphomax HL (glyphosate) - weeds - 3.2 L ha <sup>-1</sup> (1536 g a.i. ha <sup>-1</sup> ) (killing of the clover grass)
31-10-2017	Tracer (potassium bromide), 30 kg ha <sup>-1</sup>
04-01-2018	Ploughing - 25 cm depth
12-04-2018	Seed bed preparation - 3 cm depth
19-04-2018	Pig slurry application - trail hose applied and subsequent harrowed - 50.0 t ha <sup>-1</sup> - 131.5 Total-N, 113.5 NH <sub>4</sub> -N, 3.0 P, 72.5 K, 1.5 Mg and 0.1 Cu, kg ha <sup>-1</sup>
20-04-2018	Sowing spring barley cv. Quench. Depth 3.5 cm, seeding rate 170 kg ha <sup>-1</sup> , row distance 12 cm, final plant number 325 m <sup>-2</sup>
20-04-2018	Seed dressing Redigo Pro 170 FS (12.75 g prothioconazole a.i. ha <sup>-1</sup> and 1.70 g tebuconazole a.i. ha <sup>-1</sup> )
01-05-2018	BBCH stage 09 - emergence
30-05-2018	BBCH stage 20
30-05-2018	BBCH stage 31
30-05-2018	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> )
30-05-2018	Zypar (halauxifen-methyl + florasulam) - weeds - 1.0 L ha <sup>-1</sup> (6.25 g halauxifen-methyl and 5.0 g florasulam a.i. ha <sup>-1</sup> )
12-06-2018	BBCH stage 42
12-06-2018	Proline 250 EC (prothioconazole) - fungi - 0.8 L ha <sup>-1</sup> (200 g a.i. ha <sup>-1</sup> )
06-08-2018	BBCH stage 89
06-08-2018	Harvest of spring barley. Grain yield 55.5 hkg ha <sup>-1</sup> . Total-N 1.87% and total-C 43.83% - 85 % DM- Straw yield 22.35 hkg ha <sup>-1</sup> , Total-N 0.69% and total-C 43.78% - 100% DM, stubble height 10 cm
18-09-2018	Ploughing - 25 cm depth
19-09-2018	Seed bed preparation - 5 cm depth
19-09-2018	Sowing winter barley cv. Menento. Depth 3.0 cm, seeding rate 160 kg ha <sup>-1</sup> , row distance 12.5 cm, final plant number 300 m <sup>-2</sup>
19-09-2018	Redigo Pro 170 FS (12.00 g a.i. ha <sup>-1</sup> prothioconazole and 1.60 g a.i. ha <sup>-1</sup> tebuconazole) - seed dressing
19-09-2018	Rolled with a ring roller
28-09-2018	BBCH stage 09 – emergence
15-10-2018	BBCH stage 12
08-11-2018	BBCH stage 20
08-11-2018	DFF + Boxer (diflufenican and prosulfocarb) - weeds - 0.15 L ha <sup>-1</sup> + 1,0 L ha <sup>-1</sup> (75 g and 800 g a.i. ha <sup>-1</sup> ) (not monitored)
05-04-2019	BBCH stage 20-23

Date	Management practice and growth stages – Lund
05-04-2019	Biomass 168.0 g m <sup>-2</sup> - 100% DM
25-04-2019	BBCH stage 30
30-04-2019	BBCH stage 32
02-05-2019	BBCH stage 32
02-05-2019	Fertilisation 150 N 26,3 P 70 K, kg ha <sup>-1</sup>
04-05-2019	BBCH stage 49
09-05-2019	BBCH stage 49
09-05-2019	Flurostar 180 (fluroxypyr) - weeds - 0.8 L ha <sup>-1</sup> (144 g a.i. ha <sup>-1</sup> ) (not monitored)
11-05-2019	BBCH stage 49
11-05-2019	Zypar (halauxifen-methyl and florasulam) - weeds - 1.0 L ha <sup>-1</sup> (6.25 g halauxifen-methyl and 5.0 g florasulam a.i. ha <sup>-1</sup> )
13-05-2019	BBCH stage 50
13-05-2019	Biomass 247.6 g m <sup>-2</sup> - 100% DM
27-05-2019	BBCH stage 51
03-07-2019	BBCH stage 71
03-07-2019	Biomass 297.2 g m <sup>-2</sup> - 100% DM
12-07-2019	BBCH stage 89
13-07-2019	Harvest winter barley - grain yield 66.4 hkg ha <sup>-1</sup> - 100% DM, Straw yield 35.9 hkg ha <sup>-1</sup> DM not determined, stubble height 15 cm
25-08-2019	Rotor harrow sowing tillage depth 6 cm
25-08-2019	Direct drilling with deep loosening. Sowing winter rapeseed cv. InVigor 1030. Depth 2.0 cm row distance 15 cm seeding rate 2.5 kg ha <sup>-1</sup> , final plant number 25 m <sup>-2</sup> Seed dressing - Bacillus amyloliquefaciens MBI 600
28-08-2019	Glyphomax HL (glyphosate) and Clomate (clomazone) - weeds - 0.5 L ha <sup>-1</sup> + 0.25 L ha <sup>-1</sup> (240 g and 90 g a.i. ha <sup>-1</sup> ) (not monitored)
30-08-2019	BBCH stage 09 - emergence
05-09-2019	Fertilisation 19.2 N, 7.4 P, kg ha <sup>-1</sup>
17-12-2019	BBCH stage 13
17-12-2019	Kerb 400 SC (propyzamide) - weeds - 1.25 L ha <sup>-1</sup> (500 g a.i. ha <sup>-1</sup> )
17-12-2019	Belkar (picloram and halauxifen-methyl) - weeds - 0.5 L ha <sup>-1</sup> - (24 and 5 g a.i. ha <sup>-1</sup> )
20-03-2020	BBCH stage 17
23-03-2020	Fertilisation 97.9 N, 19.0 P, 47.5 K, kg ha <sup>-1</sup>
24-04-2020	Fertilisation 80.3 N, 15.6 P, 39.0 K, kg ha <sup>-1</sup>
07-05-2020	BBCH stage 50
01-08-2020	Harvest winter rapeseed. Seed yield 49.2 hkg ha <sup>-1</sup> - fresh weight. Straw yield not measured - shredded at harvest. Stubble height 45 cm
03-09-2020	Seedbed preparation, depth 3.5 cm
18-09-2020	Ploughing
18-09-2020	Seedbed preparation
20-09-2020	Sowing winter wheat cv. Sheriff. Depth 4.0 cm, rowdistance 13 cm, seeding rate 190 kg ha <sup>-1</sup>
20-09-2020	Redigo Pro 170 FS 95 mL ha <sup>-1</sup> (14.3 g a.i. ha <sup>-1</sup> prothioconazole and 1.9 g a.i. ha <sup>-1</sup> tebuconazole) - seed dressing
29-09-2020	BBCH stage 09 - emergence
06-11-2020	BBCH stage 19
06-11-2020	Buctril EC 225 (bromoxynil) - weeds - 0.42 L ha <sup>-1</sup> (94.5 g a.i. ha <sup>-1</sup> ) - not monitored
01-04-2021	Fertilisation 151.0 N, 29.0 P, 72.0 K, kg ha <sup>-1</sup>
21-04-2021	BBCH stage 22
21-04-2021	Biomass 41.4 g m <sup>-2</sup> - 100% DM
09-06-2021	BBCH stage 59
09-06-2021	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 1 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> prothioconazole and 125 g a.i. ha <sup>-1</sup> fluopyram) - monitored
17-06-2021	BBCH stage 65
17-06-2021	Biomass 1371.0 g m <sup>-2</sup> - 100% DM
09-08-2021	BBCH stage 89
09-08-2021	Biomass 1933.5 g m <sup>-2</sup> - 100% DM
19-08-2021,	Harvest winter wheat. Grain yield 92.0 hkg ha <sup>-1</sup> - 85% DM. Straw yield 50.8 hkg ha <sup>-1</sup> - fresh weight,
21-08-2021	stubbleheight 15 cm
14-02-2022	Ploughing, 25 cm depth
18-03-2022	Stubble cultivation, 5 cm depth
20-03-2022	Fertilisation 126.0 N, 18.0 P, 60.0 K, kg ha <sup>-1</sup>

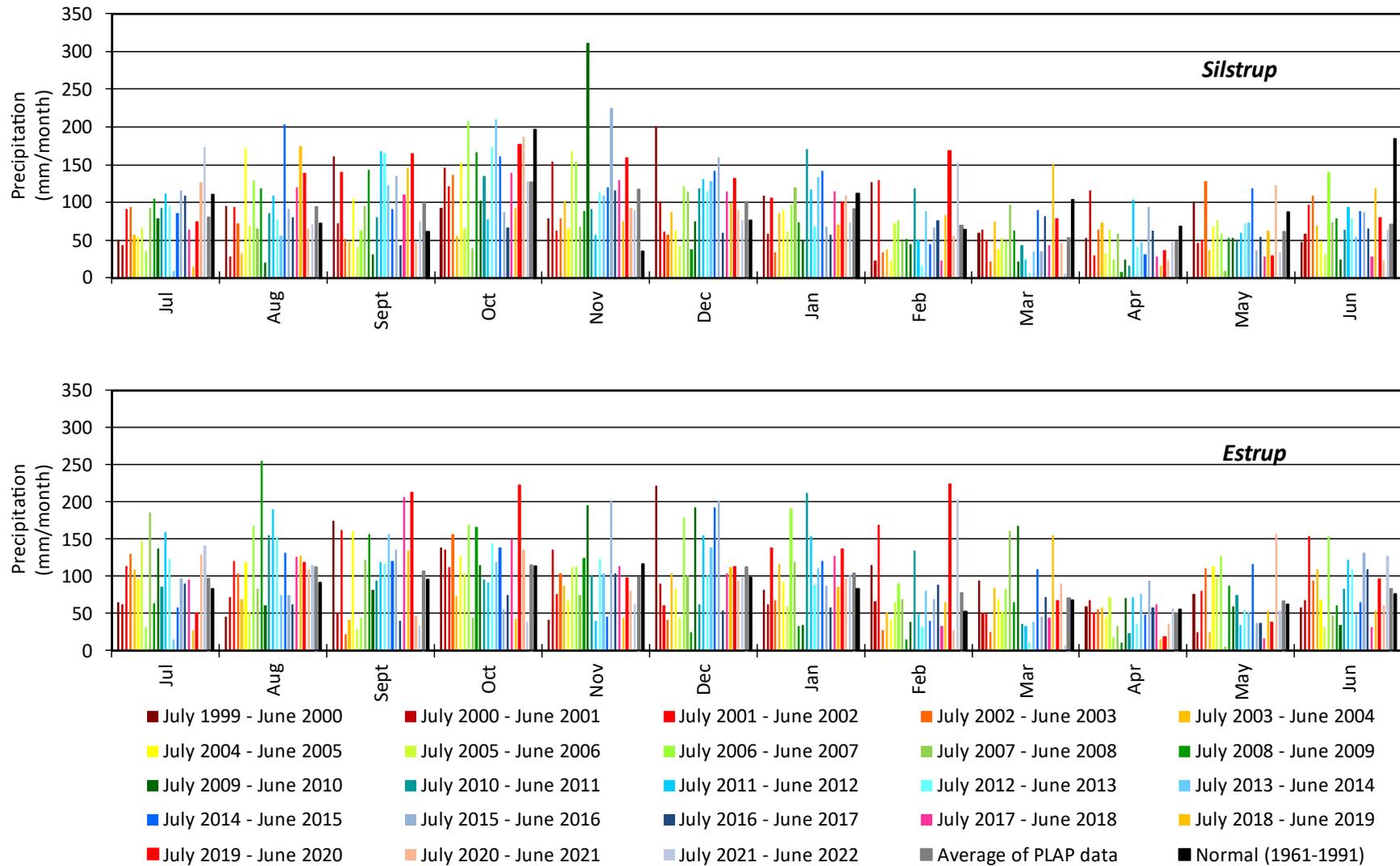
Date	Management practice and growth stages – Lund
22-03-2022	Stubble cultivation, 5 cm depth
23-03-2022	Sowing spring barley cv. Laureate, sowing depth 3.5 cm, rowdistance 13 cm, seeding rate 180 kg ha <sup>-1</sup>
23-03-2022	Redigo Pro 170 FS 90 mL ha <sup>-1</sup> (13.5 g a.i. ha <sup>-1</sup> prothioconazole and 1.8 g a.i. ha <sup>-1</sup> tebuconazol) - seed dressing
25-03-2022	Rolled with a ring roller
13-04-2022	BBCH stage 09 - emergence
27-04-2022	BBCH stage 13
10-05-2022	BBCH stage 24
10-05-2022	Biomass 53.2 g m <sup>-2</sup> - 100% DM
10-05-2022	Nuance Max 75 WG (tribenuron-methyl) - weeds - 10 g ha <sup>-1</sup> (7.5 g a.i. ha <sup>-1</sup> tribenuron-methyl) - monitored
24-05-2022	BBCH stage 37
31-05-2022	BBCH stage 48
31-05-2022	Biomass 410.8 g m <sup>-2</sup> - 100% DM
31-05-2022	Propulse SE 250 (prothioconazole and fluopyram) - fungi - 1 L ha <sup>-1</sup> (125 g a.i. ha <sup>-1</sup> prothioconazole and 125 g a.i. ha <sup>-1</sup> fluopyram) - monitored
23-06-2022	BBCH stage 71

**Appendix 4**

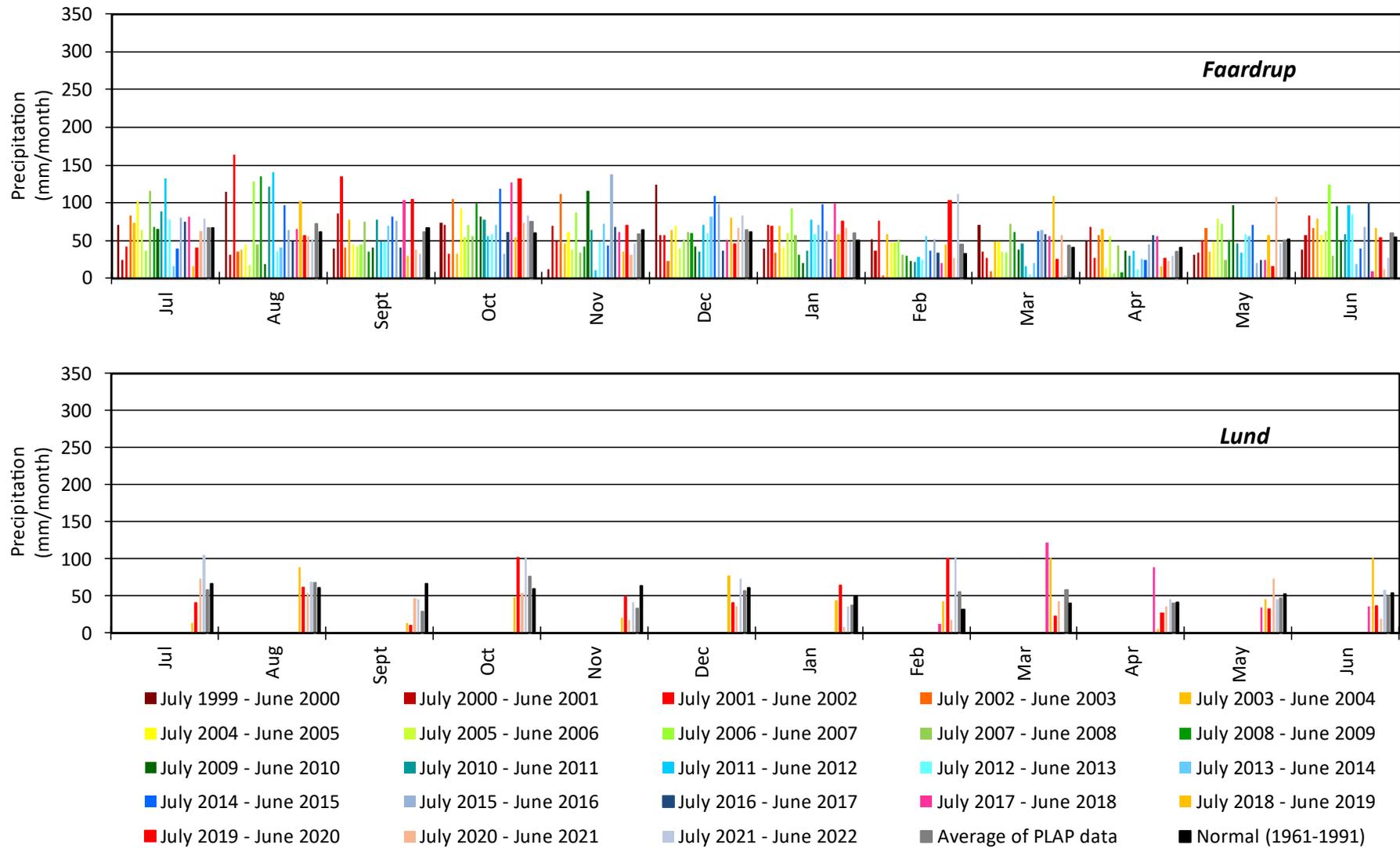
**Precipitation at the PLAP fields**



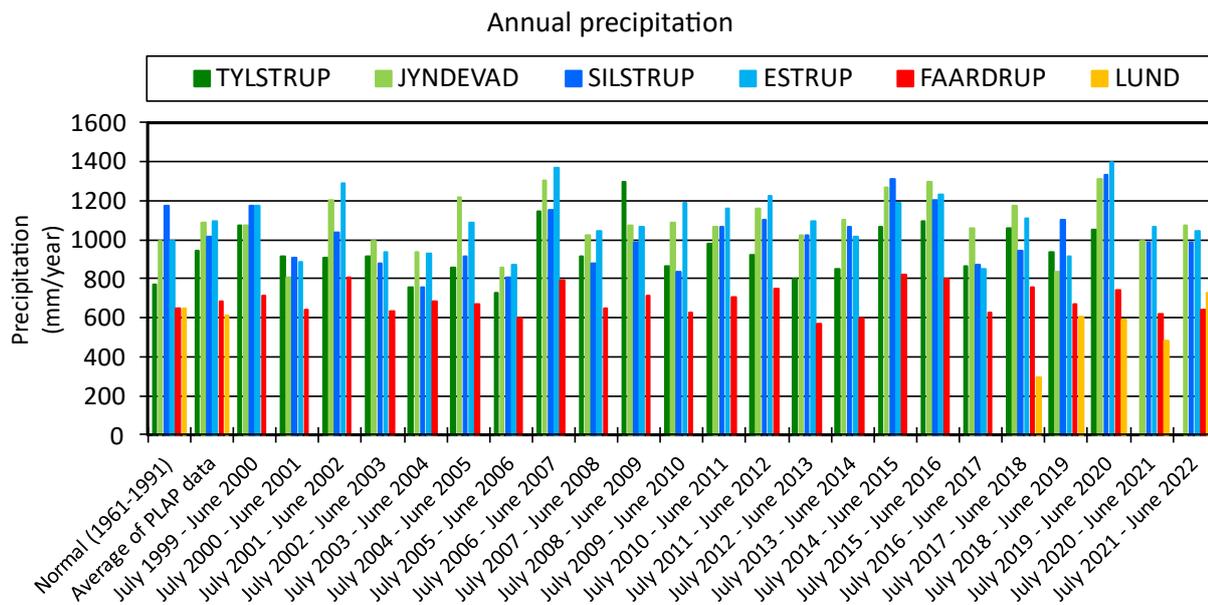
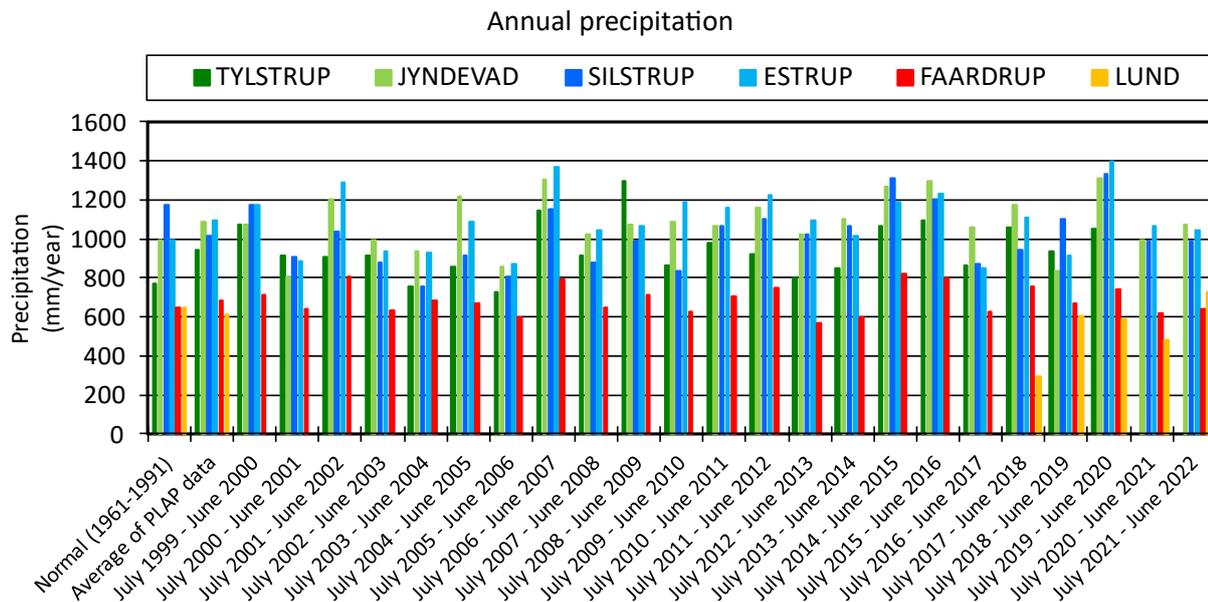
**Figure A4.1.** Monthly precipitation at all PLAP fields for the monitoring period July 2000–June 2022. Regional normal values (1961–1990) are included for comparison.



**Figure A4.1 (continued).** Monthly precipitation at all PLAP fields for the monitoring period July 2000–June 2022. Regional normal values (1961–1990) are included for comparison.



**Figure A4.1 (continued).** Monthly precipitation at all PLAP fields for the monitoring period July 2000–June 2022. Regional normal values (1961–1990) are included for comparison.



**Figure A4.2.** Top: Annual precipitation at the PLAP fields during the period July 1999 – June 2022. Bottom: Average monthly precipitation for each PLAP field during the period July 1999 – June 2022. Note that data from 2017-2018 for Lund only covers February-June 2018.

**Appendix 5**

**Pesticide detections in samples from drains, suction cups and groundwater screens**

**Table A5.1.** Number of samples, where pesticides were not detected (nd), detected in concentrations  $\leq 0.1$   $\mu\text{g/L}$  or detected in concentrations  $> 0.1$   $\mu\text{g/L}$  at **Tylstrup**. Monitoring at the field was suspended on 1 January 2019, and numbers are accumulated until that date.

Tylstrup		Horizontal screens				Vertical screens				Suction cups			
		nd	$\leq 0.1$ $\mu\text{g/L}$	$> 0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$> 0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$> 0.1$ $\mu\text{g/L}$	T
Aminopyralid	Aclonifen	4	0	0	4	123	0	0	123	68	0	0	68
	Aminopyralid	27	0	0	27	183	2	0	185	91	0	0	91
Azoxystrobin	Azoxystrobin					216	0	0	216	95	0	0	95
	CyPM					216	0	0	216	95	0	0	95
Bentazone	Bentazone	24	0	0	24	486	0	0	486	198	4	0	202
	2-amino-N-isopropyl-benzamide					191	0	0	191	72	0	0	72
	6-hydroxy-bentazone	24	0	0	24	156	0	0	156	65	0	0	65
	8-hydroxy-bentazone	24	0	0	24	156	0	0	156	65	0	0	65
Bifenox	N-methyl-bentazone	24	0	0	24	156	0	0	156	65	0	0	65
	Bifenox	8	0	0	8	41	0	0	41	22	0	0	22
	Bifenox acid	8	0	0	8	41	0	0	41	22	0	0	22
Boscalid	Nitrofen	8	0	0	8	41	0	0	41	22	0	0	22
	Boscalid	9	0	0	9	102	0	0	102	56	0	0	56
	Bromoxynil					192	0	0	192	72	0	0	72
Clomazone	Clomazone					224	0	0	224	82	0	0	82
	FMC 65317					208	0	0	208	74	0	0	74
Clopyralid	Clopyralid					132	0	0	132	102	1	1	104
Cyazofamid	Cyazofamid	4	0	0	4	123	0	0	123	68	0	0	68
Dimethoate	Dimethoate					176	0	0	176	63	0	0	63
Epoxiconazole	Epoxiconazole					199	0	0	199	74	0	0	74
Fenpropimorph	Fenpropimorph					307	0	0	307	89	0	0	89
	Fenpropimorph acid					276	0	0	276	73	0	0	73
Flamprop-M-isopropyl	Flamprop-M-isopropyl					176	0	0	176	63	0	0	63
	Flamprop					176	0	0	176	63	0	0	63
Fluazifop-P-butyl	Fluazifop-P					178	0	0	178	63	0	0	63
	TFMP					3	0	0	3				
Fludioxonil	CGA 192155	22	0	0	22	160	0	0	160	65	0	0	65
	CGA 339833	22	0	0	22	160	0	0	160	65	0	0	65
Fluroxypyr	Fluroxypyr					194	0	0	194	68	0	0	68
loxynil	loxynil					198	0	0	198	72	0	0	72
Linuron	Linuron					270	0	0	270	67	0	0	67
mancozeb	EBIS	8	0	0	8	70	0	0	70	27	0	0	27
	ETU					198	2	0	200	37	7	0	44
Mesosulfuron-methyl	AE-F099095	16	0	0	16	128	0	0	128	54	0	0	54
	AE-F160459	16	0	0	16	128	0	0	128	54	0	0	54
	metalaxyl-M	28	0	0	28	303	21	0	324	152	4	0	156
Metribuzin	CGA 108906	3	25	0	28	61	216	47	324	25	93	35	153
	CGA 62826	27	1	0	28	308	16	0	324	119	30	5	154
	Metribuzin					386	1	0	387	89	2	0	91
Pendimethalin	Desamino-diketo-metribuzin					289	231	5	525	166	30	51	247
	Desamino-metribuzin					365	0	0	365	85	0	0	85
	Diketo-metribuzin					59	138	315	512	65	192	61	318
	Pendimethalin					430	0	0	430	144	0	0	144
Pirimicarb	Pirimicarb					295	0	0	295	82	0	0	82
	Pirimicarb-desmethyl					295	0	0	295	81	0	0	81

Tylstrup		Horizontal screens				Vertical screens				Suction cups			
		nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T
	Pirimicarb-desmethyl-formamido					167	0	0	167	52	0	0	52
Propiconazole	Propiconazole					307	0	0	307	89	0	0	89
Propyzamide	Propyzamide					221	0	0	221	82	0	0	82
	RH-24580					221	0	0	221	82	0	0	82
	RH-24644					221	0	0	221	82	0	0	82
	RH-24655					157	0	0	157	58	0	0	58
Prosulfocarb	Prosulfocarb	20	0	0	20	144	4	0	148	73	1	0	74
Rimsulfuron	Rimsulfuron					178	0	0	178	65	0	0	65
	PPU	9	0	0	9	589	58	0	647	74	191	3	268
	PPU-desamino	9	0	0	9	638	9	0	647	205	63	0	268
Tebuconazole	Tebuconazole					195	1	0	196	77	0	0	77
	1,2,4-triazole	6	30	0	36	149	81	0	230	78	18	2	98
Terbuthylazine	Terbuthylazine					179	0	0	179	72	0	0	72
	2-hydroxy-desethyl-terbuthylazine					190	1	0	191	67	5	0	72
	Desethyl-terbuthylazine					191	0	0	191	70	2	0	72
	Desisopropylatrazine					190	1	0	191	55	17	0	72
	Hydroxy-terbuthylazine					191	0	0	191	71	1	0	72
Thiamethoxam	Thiamethoxam					175	0	0	175	64	0	0	64
	CGA 322704					175	0	0	175	64	0	0	64
Triasulfuron	Triasulfuron					295	0	0	295	82	0	0	82
	Triazinamin					285	0	0	285	75	0	0	75
Tribenuron-methyl	Triazinamin-methyl					440	0	0	440	137	0	0	137

**Table A5.2.** Number of samples where pesticides were either not detected (nd), detected in concentrations  $\leq 0.1$   $\mu\text{g/L}$ , or detected in concentrations  $>0.1$   $\mu\text{g/L}$  at **Jyndeavad**. Numbers are accumulated for the period up to 1 July 2022.

Jyndeavad		Horizontal screens				Vertical screens				Suction cups			
		nd	$\leq 0.1$ $\mu\text{g/L}$	$>0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$>0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$>0.1$ $\mu\text{g/L}$	T
Acetamiprid	Acetamiprid												
	IM-1-4	16	0	0	16	195	0	0	195	54	0	0	54
	IM-1-5	16	0	0	16	195	0	0	195	54	0	0	54
Aclonifen	Aclonifen	9	0	0	9	162	0	0	162	43	0	0	43
Amidosulfuron	Amidosulfuron					88	0	0	88	20	2	1	23
	desmethyl-amidosulfuron					88	0	0	88	23	0	0	23
Azoxystrobin	Azoxystrobin					233	0	0	233	65	0	0	65
	CyPM					233	0	0	233	65	0	0	65
Bentazone	Bentazone	50	2	0	52	849	1	0	850	121	92	17	230
	2-amino-N-isopropyl-benzamide					178	0	0	178	45	2	0	47
	6-hydroxy-bentazone	22	0	0	22	207	0	0	207	43	0	0	43
	8-hydroxy-bentazone	22	0	0	22	207	0	0	207	43	0	0	43
	N-methyl-bentazone	22	0	0	22	207	0	0	207	43	0	0	43
Bifenox	Bifenox	4	0	0	4	216	2	0	218	54	2	0	56
	Bifenox acid	4	0	0	4	166	0	0	166	52	1	0	53
	Nitrofen	4	0	0	4	218	0	0	218	56	0	0	56
Bromoxynil	Bromoxynil					218	0	0	218	61	0	0	61
Chlormequat	Chlormequat					14	0	0	14	28	0	0	28
Clomazone	Clomazone	13	0	0	13	91	0	0	91	23	0	0	23
	FMC 65317	13	0	0	13	92	0	0	92	23	0	0	23
Cyazofamid	Cyazofamid	4	0	0	4	131	0	0	131	32	0	0	32
	CCIM	16	0	0	16	195	0	0	195	54	0	0	54
	CTCA	16	0	0	16	195	0	0	195	54	0	0	54
	DMSA	12	1	3	16	139	21	35	195	43	5	6	54
	N,N-DMS	2	7	7	16	129	30	36	195	12	29	13	54
Cycloxydim	BH 517-T2SO2	12	0	0	12	195	0	0	195	39	0	0	39
	EZ-BH 517-TSO	10	2	0	12	188	0	0	188	28	8	3	39
Diflufenican	Diflufenican	12	0	0	12	140	0	0	140	38	0	0	38
	AE-0542291	12	0	0	12	140	0	0	140	38	0	0	38
	AE-B107137	12	0	0	12	140	0	0	140	52	0	0	52
Dimethoate	Dimethoate					190	0	0	190	52	0	0	52
Epoxiconazole	Epoxiconazole					323	1	0	324	90	0	0	90
Fenpropimorph	Fenpropimorph					253	1	0	254	78	1	0	79
	Fenpropimorph acid					260	0	0	260	79	0	0	79
Florasulam	Florasulam					191	0	0	191	54	0	0	54
	Florasulam-desmethyl									28	0	0	28
Fluazifop-P-butyl	Fluazifop-P					190	0	0	190	51	0	0	51
	TFMP					3	0	0	3				
Fludioxonil	CGA 192155	28	0	0	28	203	1	0	204	34	0	0	34
	CGA 339833	28	0	0	28	192	0	1	193	34	0	0	34
Fluopyram	Fluopyram	5	0	0	5	36	0	0	36	10	0	0	10
	Fluopyram-7-hydroxy	5	0	0	5	36	0	0	36	10	0	0	10
Flupyrulfuron-methyl	Flupyrulfuron-methyl	28	0	0	28	201	0	0	201	30	0	0	30
	IN-JV460	28	0	0	28	201	0	0	201	30	0	0	30
	IN-KC576	28	0	0	28	201	0	0	201	30	0	0	30
	IN-KF311	8	0	0	8	149	0	0	149	32	0	0	32
	IN-KY374	28	0	0	28	201	0	0	201	26	1	3	30
Fluroxypyr	Fluroxypyr					193	0	0	193	55	0	0	55
Foramsulfuron	AE-F092944	1	0	0	1	6	0	0	6	2	0	0	2
Glyphosate	Glyphosate					223	0	0	223	69	0	0	69

Jynde vad		Horizontal screens				Vertical screens				Suction cups			
		nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T
	AMPA					221	2	0	223	68	1	0	69
loxynil	loxynil					218	0	0	218	61	0	0	61
mancozeb	EBIS	12	0	0	12	87	0	0	87	10	0	0	10
MCPA	MCPA					210	0	0	210	56	0	0	56
	2-methyl-4-chlorophenol					210	0	0	210	56	0	0	56
Mesosulfuron-methyl	Mesosulfuron-methyl					285	0	0	285	78	0	0	78
	AE-F099095	10	0	0	10	186	0	0	186	43	0	0	43
	AE-F147447	8	2	0	10	186	0	0	186	47	0	0	47
	AE-F160459	10	0	0	10	179	0	0	179	43	0	0	43
	Mesosulfuron					12	0	0	12	45	0	0	45
Mesotrione	Mesotrione	30	0	0	30	207	0	0	207	67	0	0	67
	AMBA	30	0	0	30	207	0	0	207	67	0	0	67
	MNBA	30	0	0	30	207	0	0	207	67	0	0	67
metalaxyl-M	metalaxyl-M	18	8	5	31	286	57	18	361	84	11	0	95
	CGA 108906	2	23	6	31	113	171	78	362	37	34	34	105
	CGA 62826	2	20	9	31	217	145	0	362	32	53	20	105
Metribuzin	Metribuzin					26	0	0	26	6	0	0	6
	Desamino-diketo-metribuzin					6	7	13	26	6	0	0	6
	Desamino-metribuzin					26	0	0	26	4	0	0	4
	Diketo-metribuzin					0	7	19	26	3	3	0	6
Pendimethalin	Pendimethalin					257	0	0	257	71	0	0	71
Picolinafen	Picolinafen					35	0	0	35	35	1	0	36
	CL153815					35	0	0	35	36	0	0	36
Pirimicarb	Pirimicarb					251	0	0	251	69	0	0	69
	Pirimicarb-desmethyl					251	0	0	251	68	1	0	69
	Pirimicarb-desmethyl-formamido					251	0	0	251	69	0	0	69
Propiconazole	Propiconazole					287	0	0	287	87	0	0	87
Proquinazid	Proquinazid												
	IN-MM671	12	0	0	12	175	0	0	175	48	0	0	48
	IN-MM991	12	0	0	12	175	0	0	175	48	0	0	48
Pyridate	Pyridate					116	0	0	116	39	0	0	39
	PHCP					184	0	0	184	59	0	0	59
Rimsulfuron	Rimsulfuron					189	0	0	189	52	0	0	52
	PPU	0	1	6	7	489	361	6	856	39	130	64	233
	PPU-desamino	0	7	0	7	765	91	0	856	110	117	6	233
Tebuconazole	Tebuconazole					213	1	0	214	58	0	0	58
	1,2,4-triazol	31	39	0	70	283	440	6	729	82	82	9	173
Terbuthylazine	Terbuthylazine					260	0	0	260	79	0	0	79
	Desethyl-terbuthylazine					490	27	0	517	130	20	0	150
Thifensulfuron-methyl	IN-B5528	5	0	0	5	36	0	0	36	10	0	0	10
Thiophanate-methyl	Carbendazim	12	0	0	12	226	0	0	226	60	0	0	60
Tribenuron-methyl	IN-R9805	5	0	0	5	36	0	0	36	10	0	0	10
	M2	5	0	0	5	36	0	0	36	10	0	0	10
	Triazinamin-methyl					248	0	0	248	77	0	0	77

**Table A5.3.** Number of samples where pesticides were either not detected (nd), detected in concentrations ≤0.1 µg/L, or detected in concentrations >0.1 µg/L at **Silstrup**. Numbers are accumulated for the period up to 1 July 2022.

Silstrup		Drainage				Horizontal screens				Vertical screens				Suction cups			
		nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T
Amidosulfuron	Amidosulfuron	1	0	0	1												
	desmethyl- amidosulfuron	1	0	0	1												
Amitrol	Amitrol	3	0	0	3	7	0	0	7	20	0	0	20				
Azoxystrobin	Azoxystrobin	165	22	1	188	231	3	0	234	405	5	0	410				
	CyPM	69	159	33	261	256	54	7	317	519	67	8	594				
Bentazone	Bentazone	75	40	5	120	133	8	1	142	244	18	2	264				
	2-amino-N-isopropyl- benzamide	65	0	0	65	74	0	0	74	131	0	0	131				
Bifenox	Bifenox	63	3	2	68	62	0	0	62	116	5	0	121				
	Bifenox acid	36	2	18	56	52	4	6	62	103	3	14	120				
	Nitrofen	63	2	3	68	62	0	0	62	121	0	0	121				
Bromoxynil	Bromoxynil	48	0	0	48	66	0	0	66	93	0	0	93				
Chlormequat	Chlormequat	20	1	0	21	36	0	0	36	66	0	0	66				
Clomazone	Clomazone	19	0	0	19	17	0	0	17	32	0	0	32				
	FMC 65317	19	0	0	19	17	0	0	17	32	0	0	32				
Clopyralid	Clopyralid	75	1	3	79	101	0	0	101	184	1	0	185				
Cycloxydim	BH 517-T2SO2	51	0	0	51	45	0	0	45	109	0	0	109				
	EZ-BH 517-TSO	36	14	1	51	30	15	0	45	87	22	0	109				
Desmedipham	Desmedipham	101	0	0	101	107	1	0	108	240	0	0	240	58	0	0	58
	EHPC	68	0	0	68	62	0	0	62	118	0	0	118	20	0	0	20
Diflufenican	Diflufenican	55	10	1	66	83	0	0	83	117	0	1	118				
	AE-0542291	66	0	0	66	83	0	0	83	118	0	0	118				
	AE-B107137	56	4	1	61	82	1	0	83	118	0	0	118				
Dimethoate	Dimethoate	81	0	1	82	73	1	0	74	148	0	0	148	27	0	0	27
Epoxiconazole	Epoxiconazole	36	0	0	36	62	0	0	62	117	0	0	117				
Ethofumesate	Ethofumesate	127	14	1	142	169	2	0	171	355	3	0	358	54	3	2	59
Fenpropimorph	Fenpropimorph	82	0	0	82	74	0	0	74	148	0	0	148	27	0	0	27
	Fenpropimorph acid	81	1	0	82	74	0	0	74	147	0	0	147	27	0	0	27
Flamprop-M- isopropyl	Flamprop-M-isopropyl	70	11	1	82	73	1	0	74	148	0	0	148	27	0	0	27
	Flamprop	73	7	0	80	74	0	0	74	148	0	0	148	26	0	0	26
Florasulam	Florasulam																
	5-OH-florasulam	51	0	0	51	42	0	0	42	100	0	0	100				
	DFP-ASTCA	51	0	0	51	42	0	0	42	100	0	0	100				
	DFP-TSA	51	0	0	51	42	0	0	42	100	0	0	100				
	TSA	105	1	0	106	91	0	0	91	215	0	0	215				
Fluazifop-P-butyl	Fluazifop-P	115	0	0	115	140	1	0	141	299	0	0	299	56	0	0	56
	TFMP	79	30	23	132	137	23	2	162	211	48	14	273				
Fluopyram	Fluopyram	15	16	1	32	29	0	0	29	59	4	0	63				
	Fluopyram-7-hydroxy	5	2	0	7	10	0	0	10	23	0	0	23				
Flupyrsulfuron- methyl	IN-KF311	69	0	0	69	44	0	0	44	100	0	0	100				
Fluroxypyr	Fluroxypyr	50	0	0	50	74	0	0	74	142	0	0	142				
Foramsulfuron	Foramsulfuron	65	8	2	75	69	3	0	72	141	2	0	143				
	AE-F092944	75	0	0	75	74	0	0	74	146	0	0	146				
	AE-F130619	65	10	0	75	66	6	0	72	140	3	0	143				
Glyphosate	Glyphosate	141	86	22	249	236	5	0	241	371	35	0	406	8	0	0	8
	AMPA	47	185	18	250	227	14	0	241	380	26	0	406	8	0	0	8
Halauxifen- methyl	X-757	53	0	0	53	45	0	0	45	105	0	0	105				
Iodosulfuron- methyl	Iodosulfuron-methyl	60	0	0	60	85	0	0	85	165	0	0	165				

Silstrup		Drainage				Horizontal screens				Vertical screens				Suction cups			
		nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T
	Metsulfuron-methyl	60	0	0	60	85	0	0	85	165	0	0	165				
Ioxynil	Ioxynil	48	0	0	48	66	0	0	66	93	0	0	93				
MCPA	MCPA	51	0	0	51	67	0	0	67	123	0	0	123				
	2-methyl-4-chlorophenol	51	0	0	51	67	0	0	67	124	0	0	124				
Mesosulfuron-methyl	Mesosulfuron-methyl																
	AE-F099095	51	0	0	51	40	0	0	40	91	0	0	91				
	AE-F147447	51	0	0	51	38	0	0	38	86	0	0	86				
	AE-F160459	51	0	0	51	40	0	0	40	91	0	0	91				
Mesotrione	Mesotrione	63	6	7	76	76	0	0	76	147	0	0	147				
	AMBA	76	0	0	76	76	0	0	76	147	0	0	147				
	MNBA	68	8	0	76	76	0	0	76	147	0	0	147				
Metamitron	Metamitron	111	28	3	142	161	10	0	171	339	17	2	358	40	10	8	58
	Desamino-metamitron	97	42	3	142	165	3	3	171	334	23	1	358	40	15	4	59
Pendimethalin	Pendimethalin	91	14	0	105	122	0	0	122	222	0	0	222				
Phenmedipham	Phenmedipham	101	0	0	101	108	0	0	108	240	0	0	240	59	0	0	59
	3-aminophenol	53	0	0	53	70	0	0	70	170	0	0	170	36	0	0	36
	MHPC	100	0	0	100	106	0	0	106	234	0	0	234	55	0	0	55
Picloram	Picloram	1	0	0	1												
Pirimicarb	Pirimicarb	160	14	0	174	210	0	0	210	433	3	0	436	59	0	0	59
	Pirimicarb-desmethyl	173	1	0	174	210	0	0	210	436	0	0	436	59	0	0	59
	Pirimicarb-desmethyl-formamido	141	0	0	141	160	0	0	160	308	0	0	308	20	0	0	20
propaquizafop	propaquizafop																
	CGA287422	73	0	0	73	56	0	0	56	137	0	0	137				
	CGA290291	73	0	0	73	56	0	0	56	137	0	0	137				
	CGA294972	73	0	0	73	56	0	0	56	137	0	0	137				
	PPA	74	0	0	74	56	0	0	56	137	0	0	137				
Propiconazole	Propiconazole	76	6	0	82	74	0	0	74	148	0	0	148	27	0	0	27
Propyzamide	Propyzamide	88	26	12	126	116	10	1	127	253	11	5	269				
	RH-24580	64	2	0	66	78	0	0	78	149	0	0	149				
	RH-24644	51	15	0	66	77	1	0	78	148	1	0	149				
	RH-24655	66	0	0	66	78	0	0	78	149	0	0	149				
Proquinazid	IN-MM671	1	0	0	1												
	IN-MM991	1	0	0	1												
Prosulfocarb	Prosulfocarb	69	4	1	74	78	1	0	79	147	0	0	147				
Prothioconazole	Prothioconazole																
	Prothioconazole-desthio																
Pyridate	Pyridate																
	PHCP	62	0	4	66	66	2	0	68	109	8	4	121				
Pyroxsulam	Pyroxsulam																
	5-OH-pyroxsulam	51	0	0	51	42	0	0	42	100	0	0	100				
	6-Cl-7-OH-pyroxsulam	51	0	0	51	42	0	0	42	100	0	0	100				
	7-OH-pyroxsulam	51	0	0	51	42	0	0	42	100	0	0	100				
	PSA	51	0	0	51	42	0	0	42	100	0	0	100				
	Pyridine sulfonamide	51	0	0	51	42	0	0	42	100	0	0	100				
Rimsulfuron	PPU	1	0	0	1												
	PPU-desamino	1	0	0	1												
Tebuconazole	Tebuconazole	17	2	0	19	15	0	0	15	23	0	0	23				
	1,2,4-triazol	4	122	6	132	42	65	2	109	172	86	2	260				
Terbutylazine	Terbutylazine	31	51	9	91	107	5	0	112	173	30	1	204				
	2-hydroxy-desethyl-terbutylazine	43	27	1	71	84	0	0	84	151	1	0	152				

Silstrup		Drainage				Horizontal screens				Vertical screens				Suction cups			
		nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T
Parent	Desethyl- terbutylazine	8	64	44	116	101	32	0	133	113	127	2	242				
	Desisopropylatrazine	28	43	0	71	84	0	0	84	148	4	0	152				
	Hydroxy- terbutylazine	45	26	0	71	84	0	0	84	152	0	0	152				
Thifensulfuron- methyl	IN-B5528	7	0	0	7	10	0	0	10	23	0	0	23				
Triasulfuron	Triazinamin	88	0	0	88	113	0	0	113	228	0	0	228				
Tribenuron- methyl	Tribenuron-methyl																
	IN-R9805	7	0	0	7	10	0	0	10	23	0	0	23				
	M2	7	0	0	7	10	0	0	10	23	0	0	23				
Triflusulfuron- methyl	Triazinamin-methyl	82	0	0	82	74	0	0	74	148	0	0	148	27	0	0	27
	Triflusulfuron-methyl	32	0	0	32	56	0	0	56	102	0	0	102				
	IN-D8526	32	0	0	32	56	0	0	56	102	0	0	102				
	IN-E7710	27	5	0	32	56	0	0	56	102	0	0	102				
	IN-M7222	32	0	0	32	55	1	0	56	102	0	0	102				

**Table A5.4.** Number of samples where pesticides were either not detected (nd), detected in concentrations  $\leq 0.1$   $\mu\text{g/L}$ , or detected in concentrations  $> 0.1$   $\mu\text{g/L}$  at **Estrup**. Numbers are accumulated for the period up to 1 July 2022.

Estrup		Drainage				Horizontal screens				Vertical screens				Suction cups			
		nd	$\leq 0.1$ $\mu\text{g/L}$	$> 0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$> 0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$> 0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$> 0.1$ $\mu\text{g/L}$	T
Amidosulfuron	Amidosulfuron	99	0	0	99	35	0	0	35	109	0	0	109				
Aminopyralid	Aminopyralid	96	0	0	96	66	0	0	66	86	0	0	86				
Amitrol	Amitrol	6	0	0	6	6	0	0	6	11	0	0	11				
Azoxystrobin	Azoxystrobin	274	126	15	415	240	1	0	241	523	2	0	525				
	CyPM	39	226	150	415	207	29	5	241	518	7	0	525				
Bentazone	Bentazone	211	208	14	433	176	42	0	218	525	2	0	527	3	2	2	7
	2-amino-N-isopropylbenzamide	237	1	0	238	80	1	0	81	271	0	0	271	5	0	0	5
Bifenox	Bifenox	91	3	1	95	60	0	0	60	132	0	0	132				
	Bifenox acid	89	6	10	105	63	0	0	63	133	0	1	134				
	Nitrofen	95	0	0	95	60	0	0	60	132	0	0	132				
Bromoxynil	Bromoxynil	136	1	2	139	41	1	0	42	125	0	0	125	3	0	0	3
Chlormequat	Chlormequat	45	1	0	46	18	0	0	18	56	0	0	56				
Clomazone	Clomazone	60	0	0	60	47	0	0	47	51	0	0	51				
	FMC 65317	60	0	0	60	47	0	0	47	51	0	0	51				
Clopyralid	Clopyralid	1	0	0	1												
Diflufenican	Diflufenican	30	15	12	57	26	0	0	26	45	0	0	45				
	AE-0542291	57	0	0	57	26	0	0	26	45	0	0	45				
	AE-B107137	40	18	0	58	38	2	0	40	49	0	0	49				
Dimethoate	Dimethoate	88	0	0	88	42	0	0	42	158	0	0	158	23	0	0	23
Epoxiconazole	Epoxiconazole	35	12	2	49	19	0	0	19	69	0	0	69				
Ethofumesate	Ethofumesate	91	27	8	126	47	0	0	47	158	0	0	158				
Fenpropimorph	Fenpropimorph	82	1	0	83	39	0	0	39	150	0	0	150	23	0	0	23
	Fenpropimorph acid	82	0	0	82	34	0	0	34	124	0	0	124	17	0	0	17
Flamprop-M-isopropyl	Flamprop-M-isopropyl	112	20	0	132	55	0	0	55	208	0	0	208	23	0	0	23
	Flamprop	119	13	0	132	55	0	0	55	208	0	0	208	23	0	0	23
Florasulam	Florasulam	92	0	0	92	35	0	0	35	125	0	0	125				
	5-OH-florasulam	60	7	1	68	42	0	0	42	76	0	0	76				
	DFP-ASTCA	68	0	0	68	42	0	0	42	76	0	0	76				
	DFP-TSA	68	0	0	68	42	0	0	42	76	0	0	76				
	Florasulam-desmethyl	81	0	0	81	30	0	0	30	100	0	0	100				
	TSA	69	0	0	69	42	0	0	42	76	0	0	76				
Flupyrsulfuron-methyl	Flupyrsulfuron-methyl IN-KF311					1	0	0	1	3	0	0	3				
Fluroxypyr	Fluroxypyr	87	1	2	90	34	0	0	34	120	1	0	121				
Foramsulfuron	Foramsulfuron	72	17	3	92	65	0	0	65	88	0	0	88				
	AE-F092944	91	1	0	92	65	0	0	65	88	0	0	88				
	AE-F130619	86	6	0	92	65	0	0	65	88	0	0	88				
Glyphosate	Glyphosate	235	234	109	578	284	6	1	291	679	41	5	725	23	0	0	23
	AMPA	79	379	120	578	291	1	0	292	719	7	0	726	23	0	0	23
Halauxifen-methyl	Halauxifen-methyl X-729	61	0	0	61	39	0	0	39	70	0	0	70				
Iodosulfuron-methyl	Metsulfuron-methyl	131	0	0	131	55	0	0	55	208	0	0	208	22	1	0	23
Ioxynil	Ioxynil	119	15	5	139	42	0	0	42	125	0	0	125	3	0	0	3
MCPA	MCPA	91	10	2	103	35	0	0	35	111	1	0	112				
	2-methyl-4-chlorophenol	102	1	0	103	35	0	0	35	112	0	0	112				
Mesosulfuron-methyl	Mesosulfuron-methyl	62	13	0	75	27	0	0	27	99	0	0	99				

Estrup		Drainage				Horizontal screens				Vertical screens				Suction cups			
		nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T
Mesotrione	AE-F099095	48	0	0	48	37	0	0	37	50	0	0	50				
	AE-F147447	20	0	0	20	16	0	0	16	19	0	0	19				
	AE-F160459	48	0	0	48	37	0	0	37	50	0	0	50				
	Mesosulfuron	74	0	0	74	24	0	0	24	83	0	0	83				
Metamitron	Mesotrione	53	30	10	93	64	2	1	67	88	2	0	90				
	AMBA	89	4	0	93	67	0	0	67	90	0	0	90				
	MNBA	82	10	1	93	67	0	0	67	87	1	0	88				
Metconazole	Metamitron	81	27	15	123	47	0	0	47	158	0	0	158				
	Desamino-metamitron	76	38	11	125	47	0	0	47	157	0	0	157				
Metconazole	Metconazole	60	1	0	61	39	0	0	39	70	0	0	70				
Metrafenone	Metrafenone	100	20	0	120	68	0	0	68	119	1	0	120				
Pendimethalin	Pendimethalin	119	4	0	123	41	0	0	41	147	0	0	147	7	0	0	7
Picolinafen	Picolinafen	64	17	0	81	40	0	0	40	118	0	0	118				
	CL153815	50	20	11	81	40	0	0	40	118	0	0	118				
	Pirimicarb	159	40	0	199	68	0	0	68	225	1	0	226	6	0	0	6
Propiconazole	Pirimicarb-desmethyl	192	0	0	192	67	0	0	67	223	0	0	223	6	0	0	6
	Pirimicarb-desmethyl-formamido	199	13	13	225	77	0	0	77	261	0	0	261	5	0	0	5
	Propiconazole	192	23	3	218	87	0	0	87	309	2	0	311	23	0	0	23
Propyzamide	Propyzamide	5	0	0	5	4	0	0	4	3	0	0	3				
Pyroxsulam	Pyroxsulam																
	5-OH-pyroxsulam	67	1	0	68	42	0	0	42	76	0	0	76				
	6-Cl-7-OH-pyroxsulam	68	0	0	68	42	0	0	42	76	0	0	76				
	7-OH-pyroxsulam	67	1	0	68	42	0	0	42	76	0	0	76				
	PSA	64	2	2	68	42	0	0	42	76	0	0	76				
	Pyridine sulfonamide	68	0	0	68	42	0	0	42	76	0	0	76				
	Tebuconazole	Tebuconazole	40	24	17	81	39	0	0	39	118	3	2	123			
Terbuthylazine	1,2,4-triazol	1	14	243	258	3	157	13	173	39	151	66	256				
	Terbuthylazine	49	78	34	161	63	0	0	63	222	1	0	223				
	2-hydroxy-desethyl-terbuthylazine	44	63	24	131	50	0	0	50	180	0	0	180				
	Desethyl-terbuthylazine	18	111	35	164	59	7	0	66	232	0	0	232				
	Desisopropylatrazine	90	70	1	161	62	1	0	63	197	26	0	223				
Thiacloprid	Hydroxy-terbuthylazine	43	72	16	131	50	0	0	50	180	0	0	180				
	Thiacloprid	47	0	0	47	34	0	0	34	66	0	0	66				
	M34	55	0	0	55	34	0	0	34	66	0	0	66				
	Thiacloprid-amide	46	1	0	47	34	0	0	34	66	0	0	66				
Thifensulfuron-methyl	Thiacloprid sulfonic acid	56	0	0	56	34	0	0	34	66	0	0	66				
	Thifensulfuron-methyl																
	IN-B5528	41	0	0	41	29	0	0	29	50	0	0	50				
	IN-JZ789	41	0	0	41	29	0	0	29	50	0	0	50				
Thiophanate-methyl	IN-L9223	41	0	0	41	29	0	0	29	50	0	0	50				
	Carbendazim	60	3	0	63	41	0	0	41	64	0	0	64				
	Triasulfuron	184	0	0	184	89	0	0	89	255	1	0	256	22	0	0	22
Tribenuron-methyl	Triazinamin-methyl	52	2	0	54	36	0	0	36	68	0	0	68				

**Table A5.5.** Number of samples where pesticides were either not detected (nd), detected in concentrations  $\leq 0.1$   $\mu\text{g/L}$ , or detected in concentrations  $>0.1$   $\mu\text{g/L}$  at **Faardrup**. Numbers are accumulated for the period up to 1 July 2022.

Faardrup		Drainage				Horizontal screens				Vertical screens				Suction cups			
		nd	$\leq 0.1$ $\mu\text{g/L}$	$>0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$>0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$>0.1$ $\mu\text{g/L}$	T	nd	$\leq 0.1$ $\mu\text{g/L}$	$>0.1$ $\mu\text{g/L}$	T
Azoxystrobin	Azoxystrobin	107	0	0	107	92	0	0	92	194	0	0	194				
	CyPM	103	4	0	107	92	0	0	92	194	0	0	194				
Bentazone	Bentazone	177	22	6	205	152	13	1	166	354	4	3	361				
Bentazone	2-amino-N-isopropyl-benzamide	68	1	0	69	61	0	0	61	132	0	0	132				
Bifenox	Bifenox	58	6	0	64	30	0	0	30	74	0	0	74				
	Bifenox acid	25	1	17	43	30	0	1	31	73	0	0	73				
	Nitrofen	58	5	1	64	30	0	0	30	74	0	0	74				
Bromoxynil	Bromoxynil	101	0	0	101	81	0	0	81	225	0	0	225	73	0	0	73
Clomazone	Clomazone	84	0	1	85	69	0	0	69	166	0	0	166				
	FMC 65317	84	0	1	85	69	0	0	69	166	0	0	166				
Clopyralid	Clopyralid	31	1	0	32	24	0	0	24	72	0	0	72				
Desmedipham	Desmedipham	99	0	0	99	66	0	0	66	165	0	0	165	29	0	0	29
	EHPC	83	0	0	83	52	0	0	52	123	0	0	123	16	0	0	16
Dimethoate	Dimethoate	77	0	0	77	58	0	0	58	148	0	0	148				
Epoxiconazole	Epoxiconazole	81	0	0	81	66	0	0	66	143	0	0	143				
Ethofumesate	Ethofumesate	150	7	6	163	104	0	0	104	226	25	6	257	27	2	0	29
Fenpropimorph	Fenpropimorph	101	0	0	101	80	1	0	81	225	0	0	225	73	0	0	73
	Fenpropimorph acid	101	0	0	101	81	0	0	81	225	0	0	225	73	0	0	73
Flamprop-M-isopropyl	Flamprop-M-isopropyl	70	1	0	71	56	0	0	56	142	0	0	142				
	Flamprop	76	1	0	77	58	0	0	58	148	0	0	148				
	TSA	35	0	0	35	26	0	0	26	115	0	0	115				
Fluazifop-P-butyl	Fluazifop-P-butyl	99	0	0	99	66	0	0	66	165	0	0	165	29	0	0	29
	Fluazifop-P	124	5	3	132	87	0	0	87	205	5	1	211	26	3	0	29
	TFMP	93	0	0	93	76	0	0	76	162	0	0	162				
Fluopyram	Fluopyram	30	0	0	30	15	0	0	15	52	0	0	52				
	Fluopyram-7-hydroxy	21	0	0	21	9	0	0	9	25	0	0	25				
Flupyr-sulfuron-methyl	Flupyr-sulfuron-methyl	36	0	0	36	51	0	0	51	123	0	0	123				
	IN-JV460	36	0	0	36	51	0	0	51	123	0	0	123				
	IN-KC576	36	0	0	36	51	0	0	51	123	0	0	123				
	IN-KY374	36	0	0	36	51	0	0	51	123	0	0	123				
Fluroxypyr	Fluroxypyr	182	0	1	183	146	1	0	147	368	0	0	368	73	0	0	73
	Fluroxypyr-methoxy-pyridine	29	0	0	29	31	0	0	31	115	0	0	115				
	Fluroxypyr-pyridinol	29	0	0	29	31	0	0	31	115	0	0	115				
Glyphosate	Glyphosate	171	4	0	175	127	1	0	128	319	4	0	323	61	1	0	62
	AMPA	165	9	1	175	128	0	0	128	321	2	0	323	57	5	0	62
Halauxifen-methyl	X-729	1	0	0	1	1	0	0	1	3	0	0	3				
	X-757	34	0	0	34	25	0	0	25	111	0	0	111				
loxynil	loxynil	99	1	0	100	81	0	0	81	224	1	0	225	73	0	0	73
MCPA	MCPA	142	1	1	144	109	0	0	109	255	0	0	255				
	2-methyl-4-chlorophenol	143	0	1	144	109	0	0	109	254	0	0	254				
Metamitron	Metamitron	187	10	2	199	126	0	0	126	323	20	4	347	29	0	0	29
	Desamino-metamitron	183	12	4	199	126	0	0	126	299	36	12	347	29	0	0	29
	MTM-126-AMT	33	0	0	33	22	0	0	22	86	0	0	86				
Metrafenone	Metrafenone	60	0	0	60	54	0	0	54	114	0	0	114				
Pendimethalin	Pendimethalin	55	2	0	57	55	0	0	55	125	0	0	125				
Phenmedipham	Phenmedipham	99	0	0	99	66	0	0	66	163	2	0	165	29	0	0	29

Faardrup		Drainage				Horizontal screens				Vertical screens				Suction cups			
		nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T	nd	≤ 0.1 µg/L	>0.1 µg/L	T
Parent	Compound/analyte	97	1	1	99	66	0	0	66	164	1	0	165	29	0	0	29
Picloram	Picloram	1	0	0	1	1	0	0	1	3	0	0	3				
Pirimicarb	Pirimicarb	148	7	0	155	116	0	0	116	318	2	0	320	73	0	0	73
	Pirimicarb-desmethyl	94	6	0	100	66	0	0	66	162	3	0	165	29	0	0	29
Pirimicarb	Pirimicarb-desmethyl- formamido	97	3	0	100	66	0	0	66	163	2	0	165	29	0	0	29
Propiconazole	Propiconazole	178	0	0	178	138	0	0	138	371	1	0	372	73	0	0	73
Propyzamide	Propyzamide	152	5	4	161	132	2	0	134	316	0	0	316				
	RH-24580	125	0	0	125	115	0	0	115	249	0	0	249				
	RH-24644	121	4	0	125	115	0	0	115	249	0	0	249				
	RH-24655	123	1	0	124	114	0	0	114	246	0	0	246				
Proquinazid	IN-MM671	45	0	0	45	25	0	0	25	82	0	0	82				
	IN-MM991	45	0	0	45	25	0	0	25	82	0	0	82				
Prosulfocarb	Prosulfocarb	79	0	0	79	61	0	0	61	126	0	0	126				
Prothioconazole	Prothioconazole Prothioconazole- desthio																
Tebuconazole	Tebuconazole	50	4	0	54	53	0	0	53	120	1	0	121				
	1,2,4-triazol	4	132	6	142	97	18	0	115	369	19	0	388				
Terbuthylazine	Terbuthylazine	70	30	11	111	83	5	1	89	149	25	20	194				
	2-hydroxy-desethyl- terbuthylazine	61	7	1	69	60	1	0	61	126	6	0	132				
	Desethyl- terbuthylazine	22	82	7	111	68	21	0	89	149	15	30	194				
	Desisopropyltriazine	86	24	1	111	57	32	0	89	166	28	0	194				
	Hydroxy- terbuthylazine	90	20	1	111	85	4	0	89	164	30	0	194				
Thiamethoxam	Thiamethoxam	68	0	0	68	58	0	0	58	126	0	0	126				
	CGA 322704	68	0	0	68	58	0	0	58	126	0	0	126				
Thiencarbazone- methyl	AE1394083	35	0	0	35	22	0	0	22	89	0	0	89				
Thifensulfuron- methyl	IN-B5528	21	0	0	21	9	0	0	9	25	0	0	25				
Tribenuron- methyl	IN-R9805	21	0	0	21	9	0	0	9	25	0	0	25				
	M2	21	0	0	21	9	0	0	9	25	0	0	25				
	Triazinamin-methyl	77	0	0	77	57	0	0	57	147	0	0	147				
Triflusulfuron- methyl	Triflusulfuron-methyl	63	0	0	63	38	0	0	38	92	0	0	92				
	IN-D8526	63	0	0	63	38	0	0	38	92	0	0	92				
	IN-E7710	63	0	0	63	38	0	0	38	92	0	0	92				
	IN-M7222	63	0	0	63	38	0	0	38	92	0	0	92				

**Table A5.6.** Number of samples where pesticides were either not detected (nd), detected in concentrations ≤0.1 µg/L, or detected in concentrations >0.1 µg/L at **Lund**. Numbers are accumulated for the period up to 1 July 2022.

Lund		Drainage				Horizontal screens				Vertical screens				Suction cups			
		≤ 0.1		>0.1		≤ 0.1		>0.1		≤ 0.1		>0.1		≤ 0.1		>0.1	
Parent	Compound/analyte	nd	µg/L	µg/L	T	nd	µg/L	µg/L	T	nd	µg/L	µg/L	T	nd	µg/L	µg/L	T
Azoxystrobin	Azoxystrobin	24	3	0	27					240	0	0	240				
	CyPM	6	16	3	25					229	11	0	240				
Bentazone	Bentazone	21	6	0	27					235	5	0	240				
	6-hydroxy-bentazone	22	0	0	22					146	0	0	146				
	8-hydroxy-bentazone	22	0	0	22					146	0	0	146				
	N-methyl-bentazone	21	1	0	22					146	0	0	146				
Florasulam	Florasulam																
	TSA	33	0	0	33					220	0	0	220				
Fluopyram	Fluopyram	21	2	0	23					84	0	0	84				
	Fluopyram-7-hydroxy	15	0	0	15					29	0	0	29				
Glyphosate	Glyphosate	12	13	8	33					217	2	0	219				
	AMPA	7	21	5	33					214	4	0	218				
Halauxifen-methyl	Halauxifen-methyl																
	X-729	25	0	0	25					124	0	0	124				
Picloram	Picloram	25	1	0	26					135	1	0	136				
Propyzamide	Propyzamide	16	6	3	25					122	2	0	124				
	RH-24580	25	0	0	25					124	0	0	124				
	RH-24644	23	1	1	25					124	0	0	124				
Prothioconazole	Prothioconazole																
	Prothioconazole-desthio																
Tebuconazole	1,2,4-triazol	3	55	0	58					89	227	2	318				
Thifensulfuron-methyl	IN-B5528	15	0	0	15					29	0	0	29				
Tribenuron-methyl	IN-R9805	15	0	0	15					29	0	0	29				
	M2	15	0	0	15					29	0	0	29				

## Appendix 6

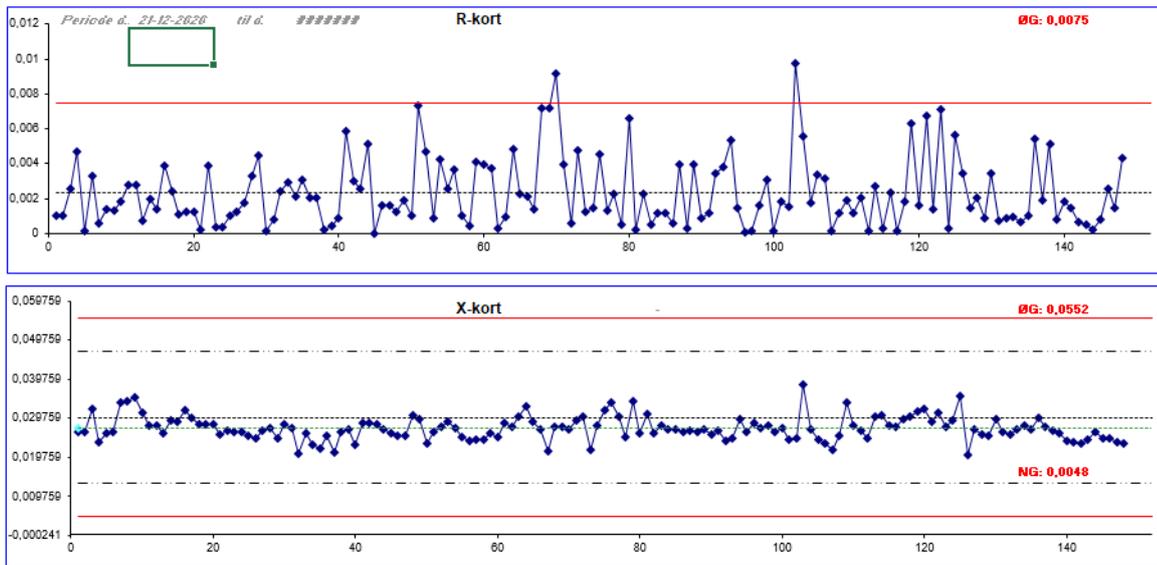
### QC charts for internal quality control

The Detection limit for all analysed compounds is 0.01 µg/L, except for DMSA, where the limit is 0.02 µg/L.

For some of the compounds, the concentration in the internal QC samples changed during the period from July 1, 2020 to June 30, 2022. These specific compounds have two QC charts, one for each of the concentration levels.

In the QC chart, the central line represents the average, and the upper- and lower lines are the upper and lower control limits, respectively. The upper chart (R-kort) shows the difference between the two QC replicates on a given day. The lower chart (X-kort) is the daily average concentration of the replicates. The table below the chart shows the method statistics: limit of detection (LD, green recalculated, yellow limit), calculated recovery (% Genf.), standard deviation within- ( $S_w$ ) and between day ( $S_b$ ), and the total standard deviation ( $S_t$ ), the coefficient of variance (CV%), the absolute- (µg/L, limit 0.05 µg/L in drinking water) and relative uncertainty (%), and the number of duplicate QC-samples (Par) included in the chart.

QC charts for the compounds included in the monitoring period from July 1, 2020 to June 30, 2022 are listed alphabetically in the following section.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	LD
S	0,006	90,6	0,00214	0,00267	0,0034	12,6	0,0089	32		148		0,01	0,05

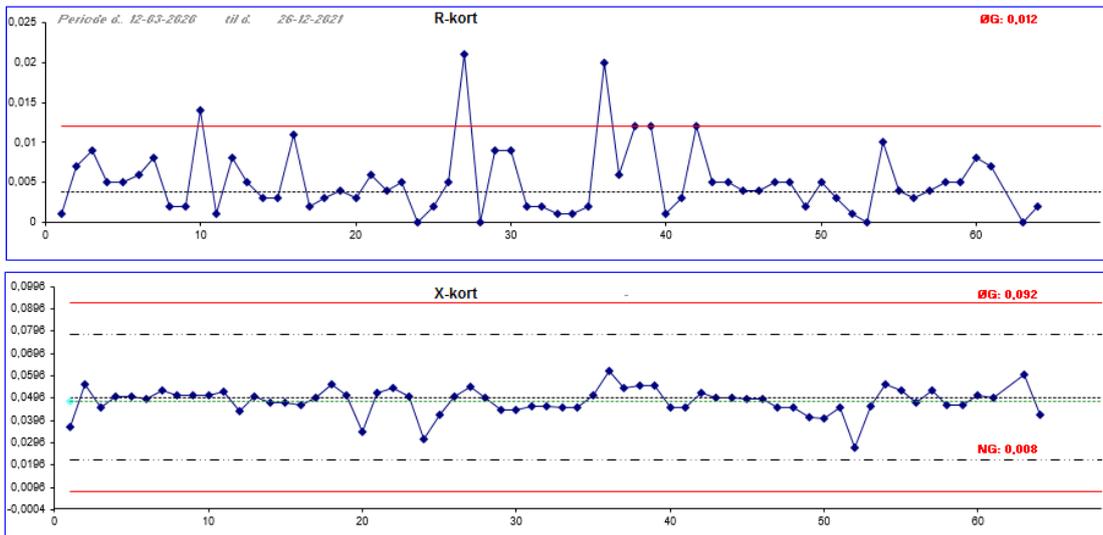
Evalueringens bemærkninger (ctrl-e):

- Flere oplysninger

Genvejtrid eller ctrl-n næste

Periode d.: 21-12-2020 til d. 27-06-2022  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 148  
 Antal udeladte Ingen

Figure A6.1. QC chart for 1,2,4-triazole.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	LD
S	0,01	96,6	0,00474	0,00503	0,0069	14,3	0,014	30	1	63		0,01	0,05

Evalueringens bemærkninger (ctrl-e):

- Flere oplysninger

Genvejtrid eller ctrl-n næste

Periode d.: 12-03-2020 til d. 26-12-2021  
 Evalueringsperiode 01-07-2019 til 26-12-2021  
 Antal punkter 63  
 Antal udeladte 1

Figure A6.2. QC chart for 5-OH-florasulam, for the period 1-7-2020 - 26-12-2021

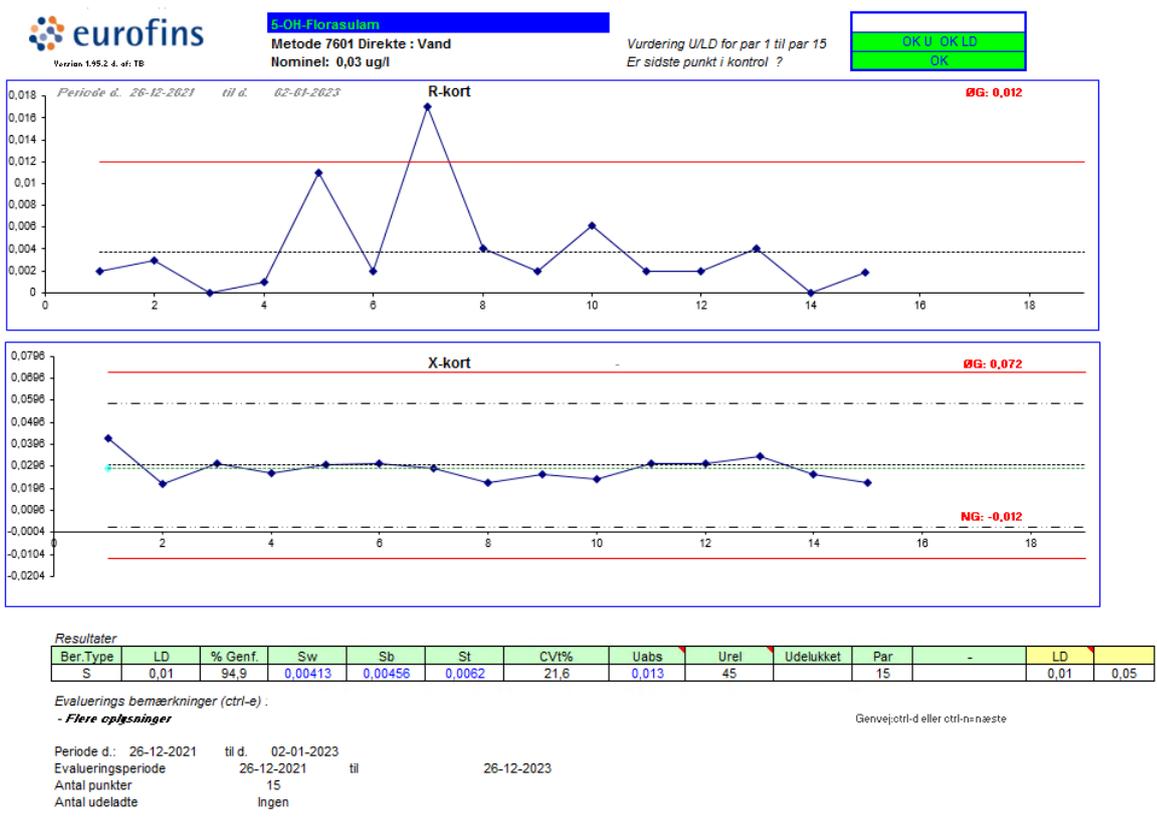


Figure A6.3. QC chart for 5-OH-florasulam, for the period 26-12-2021 - 2022-01-02

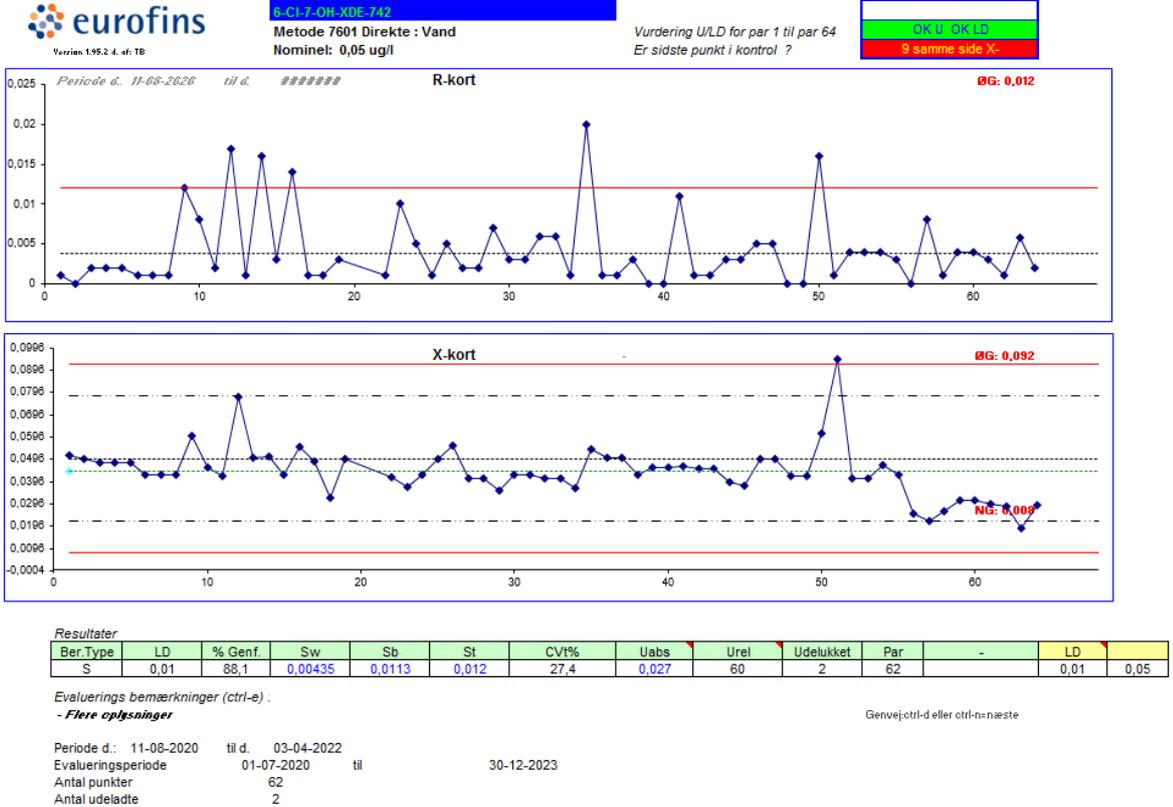
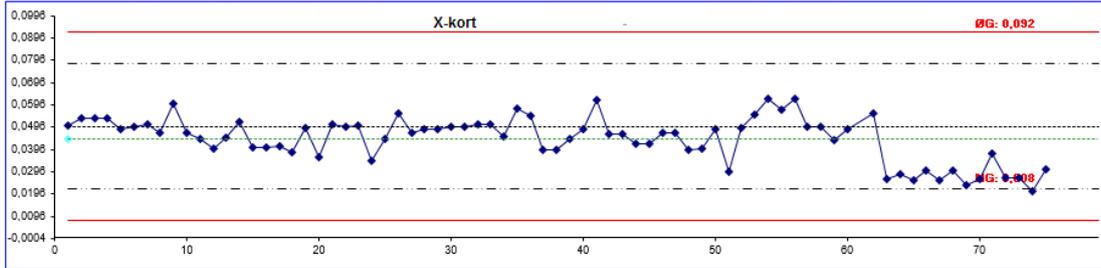
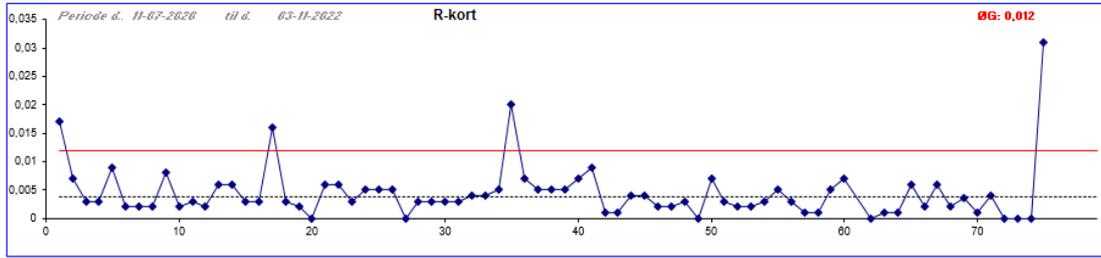


Figure A6.4. QC chart for 6-CL-7-OH-pyroxulam (6-CL-7-OH-XDE-742).



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVI%	Uabs	Urel	Udelukket	Par	-	LD
S	0,01	88,8	0,00458	0,00948	0,011	23,7	0,024	53	1	74		0,01

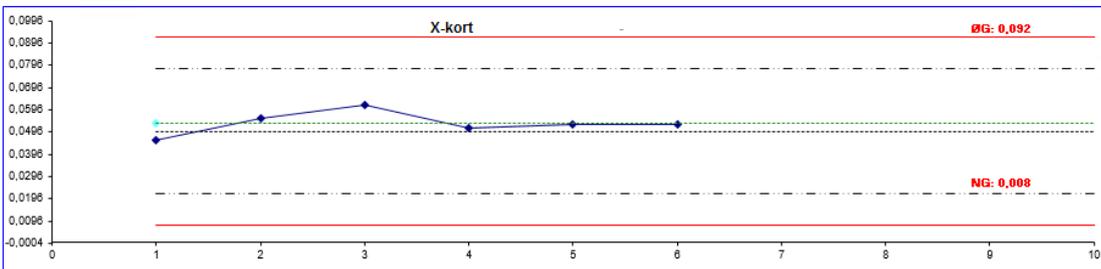
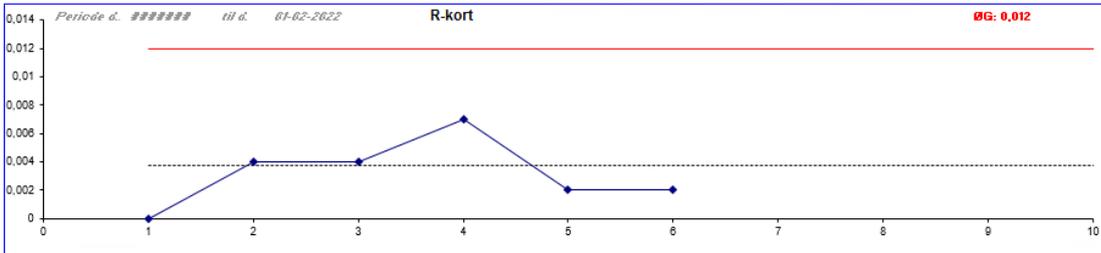
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej:ctrl-d eller ctrl-n=næste

Periode d.: 11-07-2020 til d. 03-11-2022  
 Evalueringsperiode 01-07-2020 til 30-12-2023  
 Antal punkter 74  
 Antal udeladte 1

Figure A6.5. QC chart for 7-OH-pyroxsulam (7-OH-XDE-742).



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVI%	Uabs	Urel	Udelukket	Par	-	LD
S	0,008	107,2	0,00272	0,00491	0,0056	10,5				6		0,01

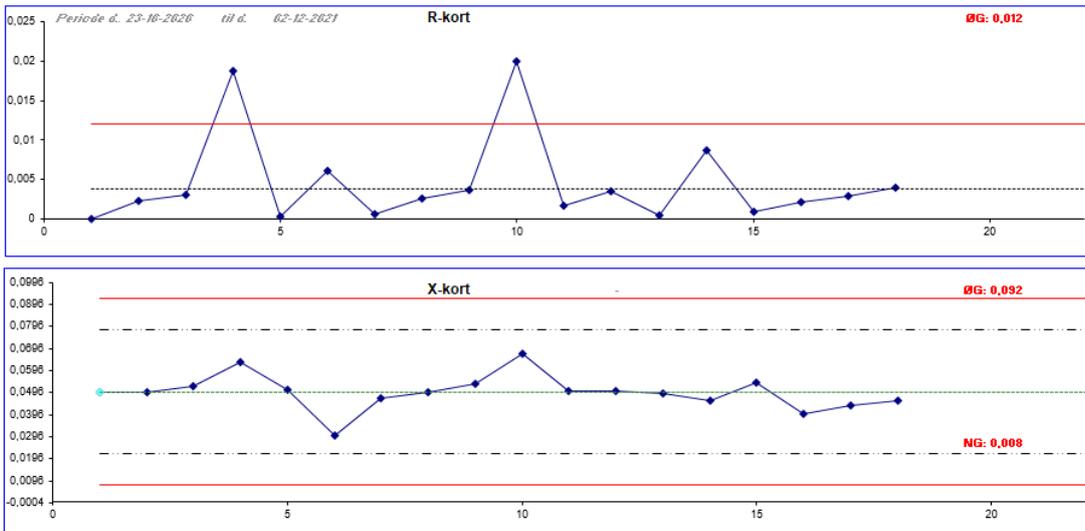
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej:ctrl-d eller ctrl-n=næste

Periode d.: 24-06-2020 til d. 01-02-2022  
 Evalueringsperiode 01-06-2020 til 30-06-2022  
 Antal punkter 6  
 Antal udeladte Ingen

Figure A6.6. QC chart for BH 517-T2SO2.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,02	99,2	0,00512	0,00705	0,0087	17,6	0,018	36		18		0,01	0,05

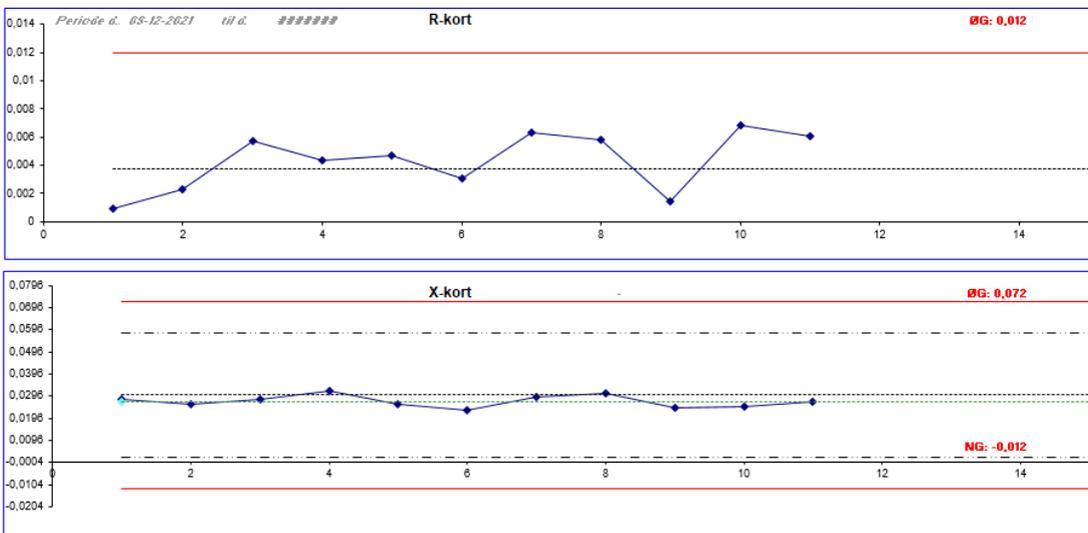
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 23-10-2020 til d. 02-12-2021  
 Evalueringsperiode 01-07-2020 til 02-12-2021  
 Antal punkter 18  
 Antal udeladte Ingen

Figure A6.7. QC chart for CCIM for the period 1-7-2020 → 2-12-2021



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	90,8	0,00337	0,00149	0,0037	13,5	0,0093	33		11		0,01	0,05

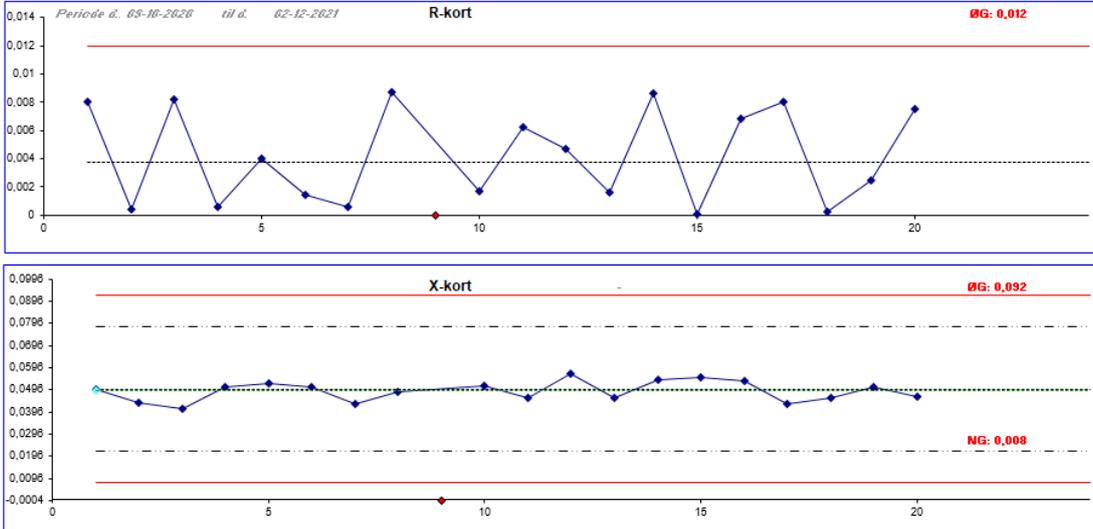
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 09-12-2021 til d. 27-06-2022  
 Evalueringsperiode 03-12-2021 til 30-06-2022  
 Antal punkter 11  
 Antal udeladte Ingen

Figure A6.8. QC chart for CCIM for the period 2021-12-09 → 2022-06-30.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	97,9	0,00376	0,00373	0,0053	10,8	0,011	22	1	19	-	0,01	0,05

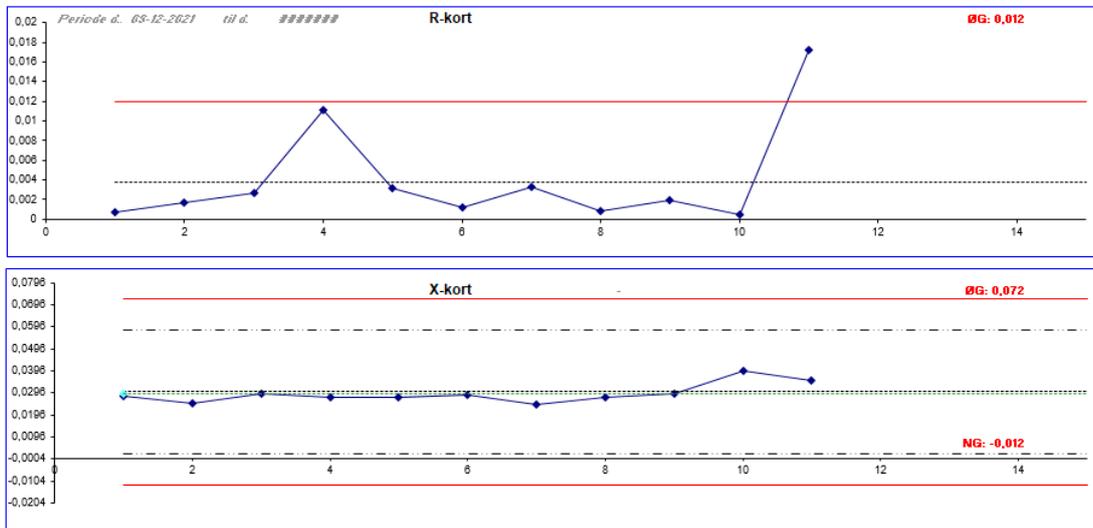
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n-næste

Periode d.: 09-10-2020 til d.: 02-12-2021  
 Evalueringsperiode 01-07-2020 til 02-12-2021  
 Antal punkter 19  
 Antal udeladte 1

Figure A6.9. QC chart for CTCA for the period 2020-10-09 → 2021-12-02.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	97,4	0,00455	0,00315	0,0055	19,0	0,011	39		11	-	0,01	0,05

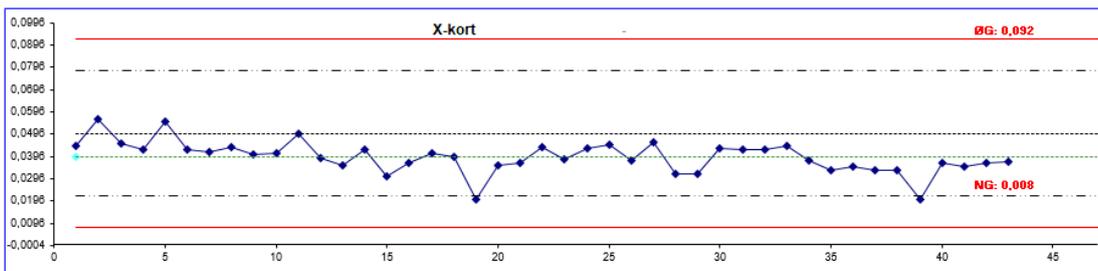
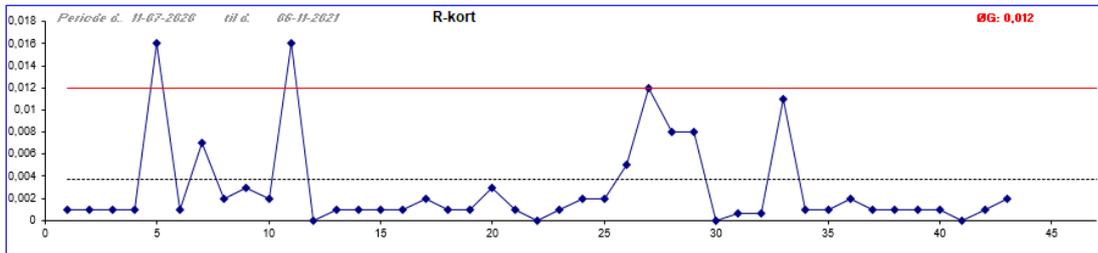
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n-næste

Periode d.: 09-12-2021 til d.: 27-06-2022  
 Evalueringsperiode 03-12-2021 til 30-06-2022  
 Antal punkter 11  
 Antal udeladte Ingen

Figure A6.10. QC chart for CTCA for the period 2021-12-09 → 2022-06-27.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD
S	0,01	78,6	0,00349	0,00657	0,0074	18,9	0,026	57		43		0,01

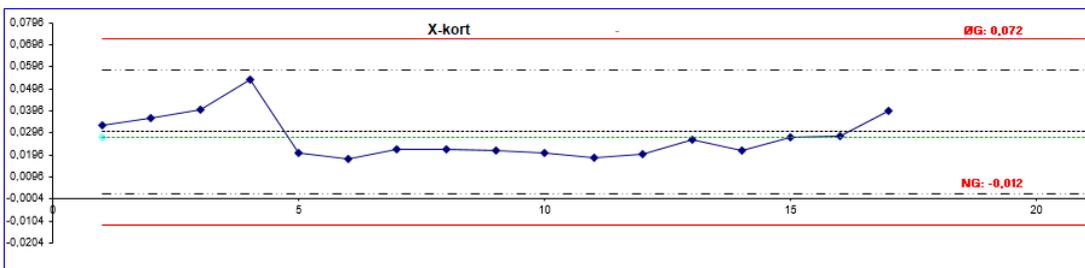
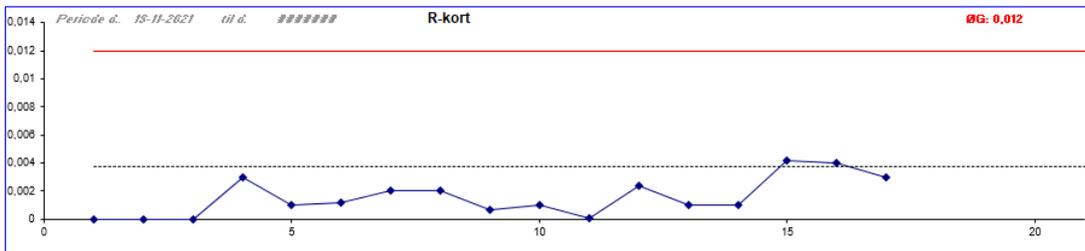
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 11-07-2020 til d.: 06-11-2021  
 Evalueringsperiode 01-07-2020 til 06-11-2021  
 Antal punkter 43  
 Antal udeladte Ingen

Figure A6.11. QC chart for CyPM for the period 2020-07-11 → 2021-11-06.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD
S	0,004	91,7	0,00144	0,00981	0,0099	36,0	0,021	76		17		0,01

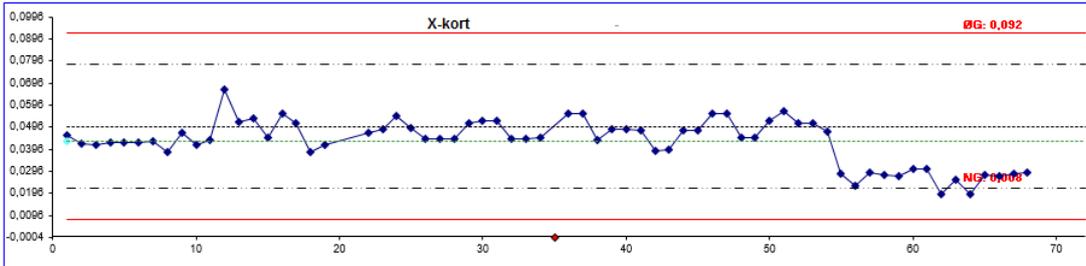
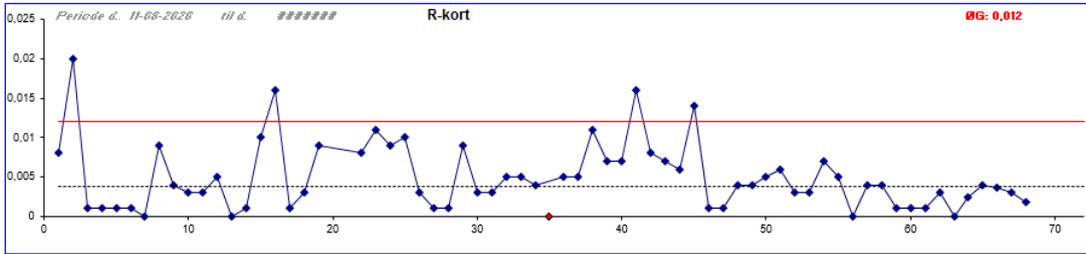
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 19-11-2021 til d.: 30-06-2022  
 Evalueringsperiode 07-11-2021 til 30-06-2022  
 Antal punkter 17  
 Antal udeladte Ingen

Figure A6.12. QC chart for CyPM for the period 2021-11-19 → 2022-06-30.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	86,4	0,00460	0,00967	0,011	24,8	0,025	57	3	65		0,01	0,05

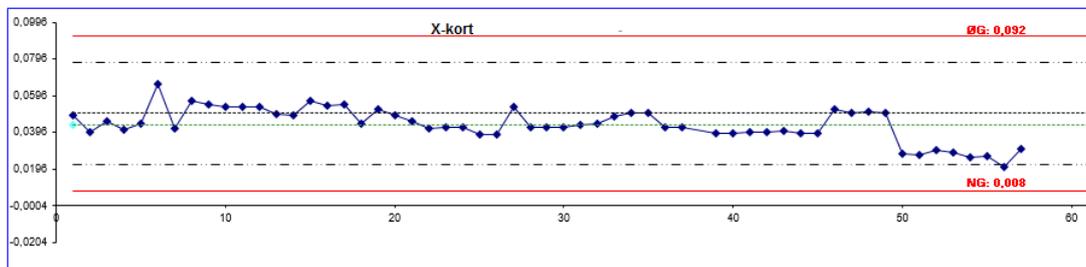
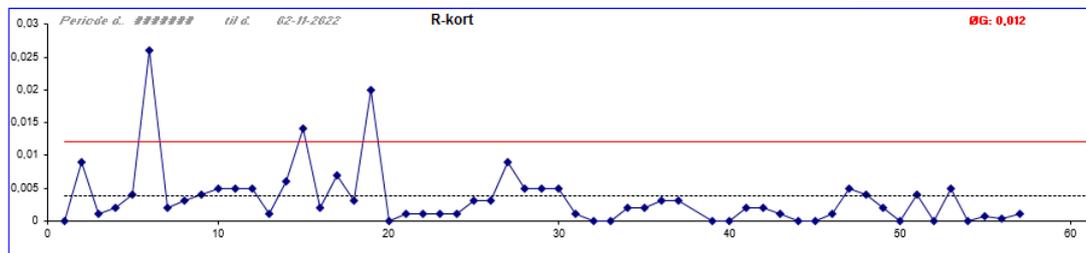
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 11-08-2020 til d.: 09-05-2022  
 Evalueringsperiode: 01-07-2020 til 30-12-2023  
 Antal punkter: 65  
 Antal udeladte: 3

Figure A6.13. QC chart for DFP-ASTCA.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	87,7	0,00410	0,00864	0,0096	21,8	0,034	100	1	56		0,01	0,05

Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 05-07-2020 til d.: 02-11-2022  
 Evalueringsperiode: 01-07-2020 til 30-12-2023  
 Antal punkter: 56  
 Antal udeladte: 1

Figure A6.14. QC chart for DFP-TSA.

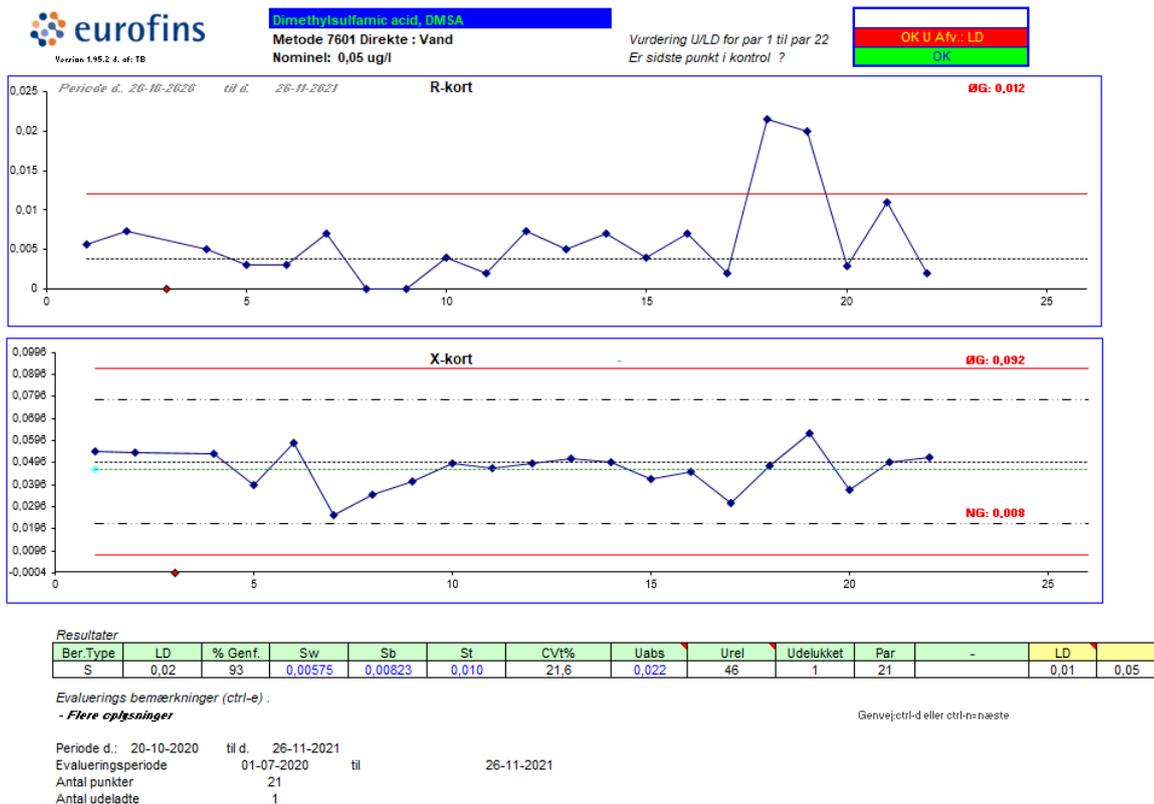


Figure A6.15. QC chart for DMSA for the period 1-7-2020 → 26-11-2021

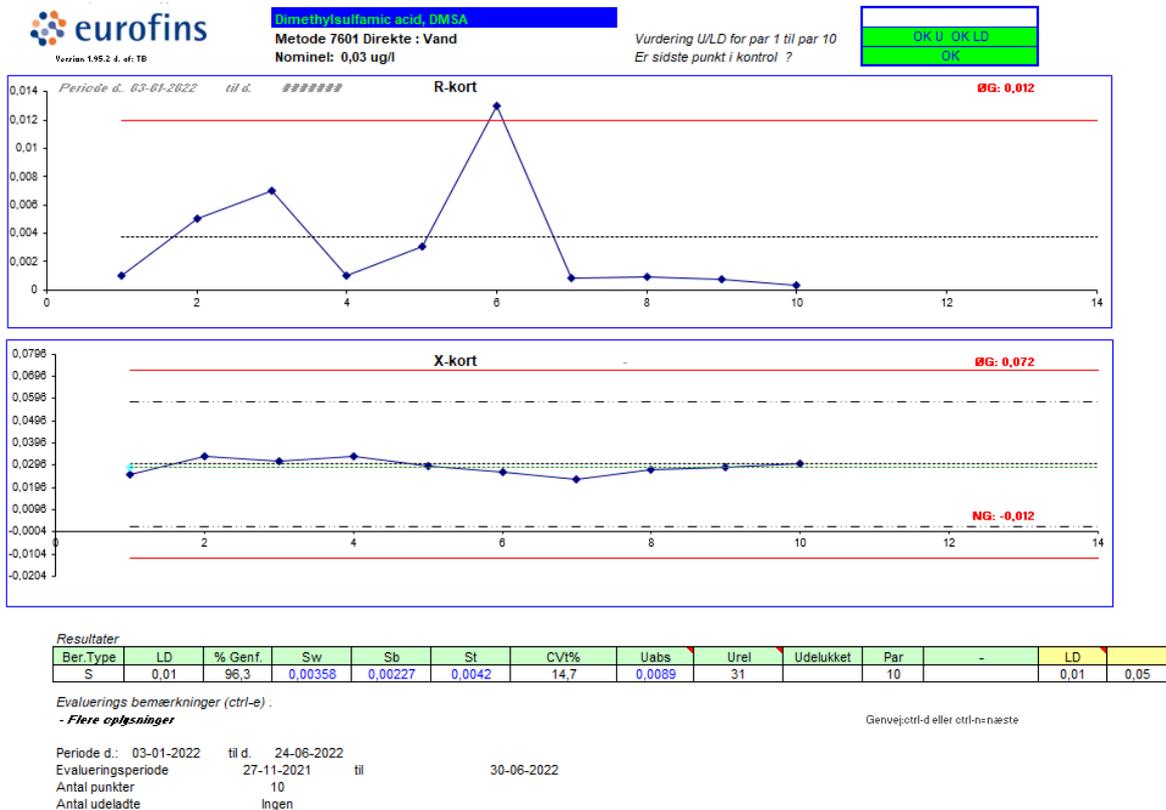
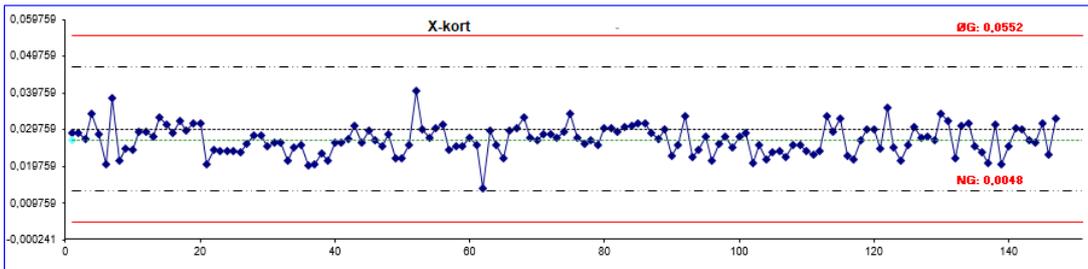
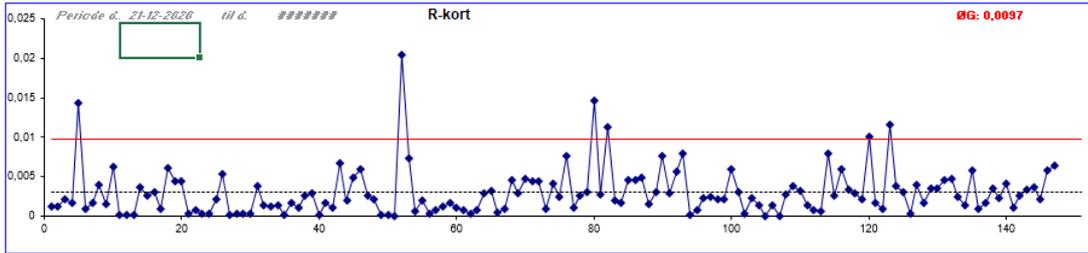


Figure A6.16. QC chart for DMSA for the period 27-11-2021 → 30-6-2022.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,009	90,1	0,00299	0,00339	0,0045	16,7	0,011	39		147		0,01	0,05

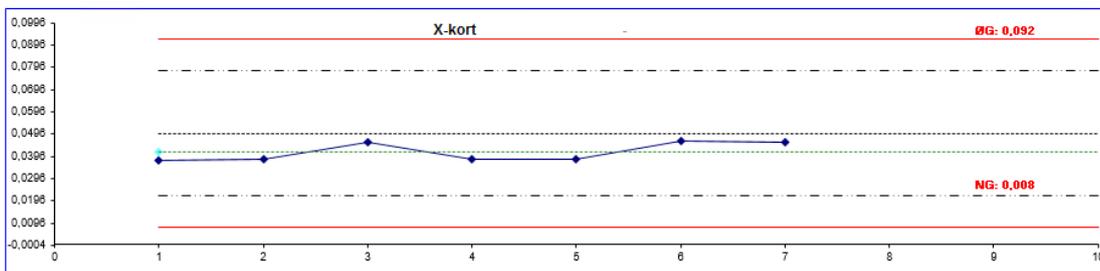
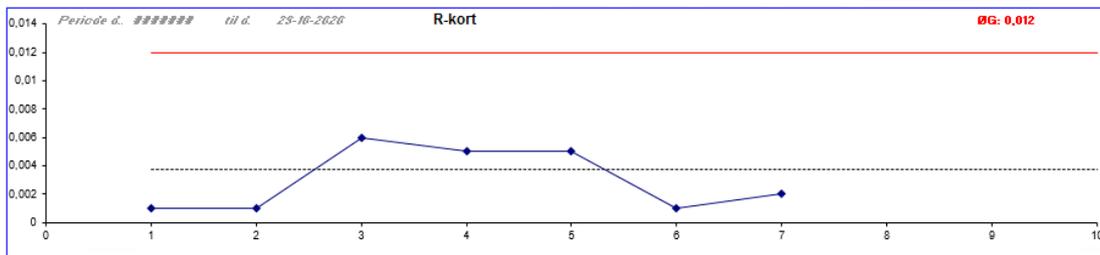
Evaluerings bemærkninger (ctrl-e) :

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 21-12-2020 til d. 27-06-2022  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 147  
 Antal udeladte Ingen

Figure A6.17. QC chart for DMS.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,008	83,3	0,00258	0,00384	0,0046	11,1				7		0,01	0,05

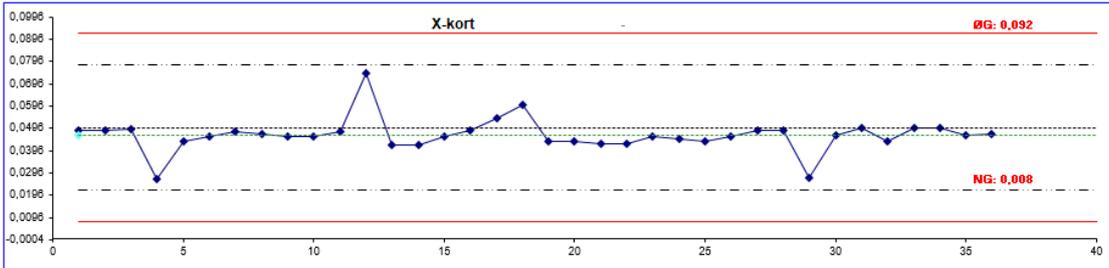
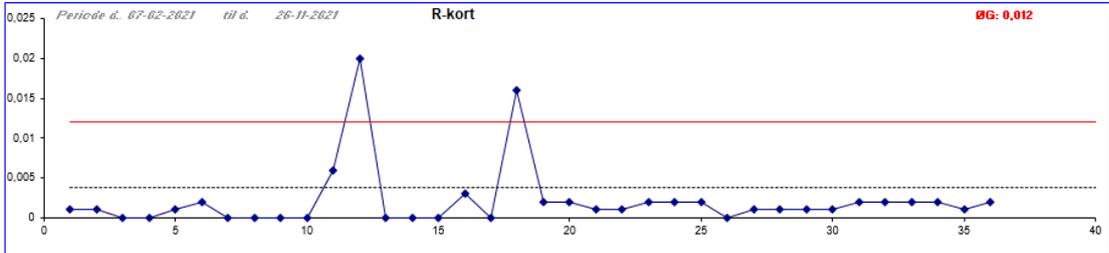
Evaluerings bemærkninger (ctrl-e) :

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 24-06-2020 til d. 29-10-2020  
 Evalueringsperiode 01-06-2020 til 30-06-2022  
 Antal punkter 7  
 Antal udeladte Ingen

Figure A6.18. QC chart for EZ BH 517-TSO.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	93,1	0,00324	0,00703	0,0077	16,6	0,017	36		36		0,01	0,05

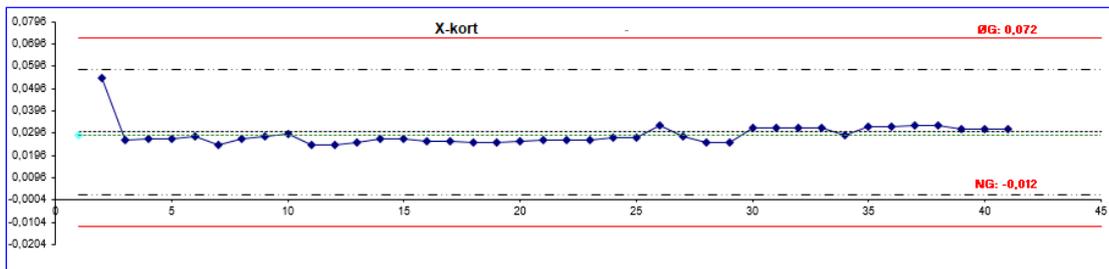
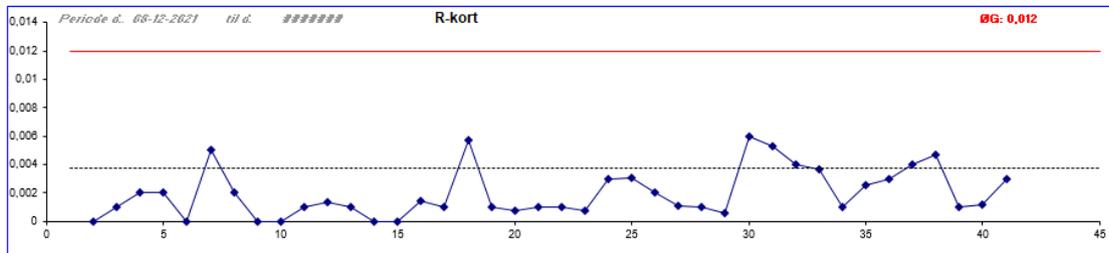
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n-næste

Periode d.: 07-02-2021 til d. 26-11-2021  
 Evalueringsperiode 01-07-2020 til 26-11-2021  
 Antal punkter 36  
 Antal udeladte Ingen

Figure A6.19. QC chart for Fluopyram for the period 1-7-2020 → 26-11-2021.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,005	96,3	0,00182	0,00479	0,0051	17,7	0,011	37	1	40		0,01	0,05

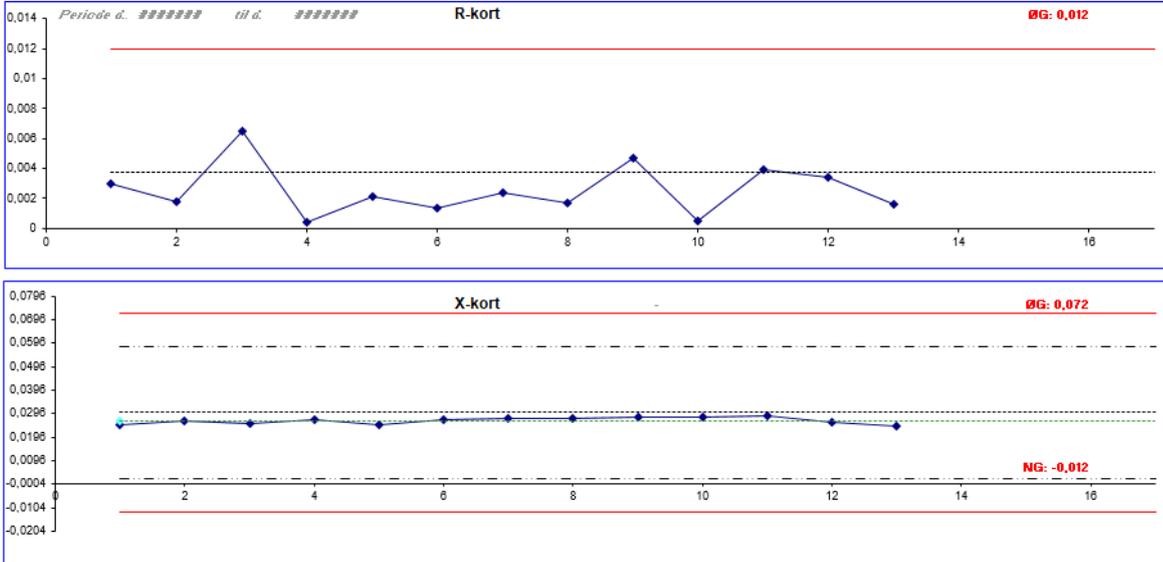
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n-næste

Periode d.: 08-12-2021 til d. 30-06-2022  
 Evalueringsperiode 27-11-2021 til 30-06-2022  
 Antal punkter 40  
 Antal udeladte 1

Figure 20. QC chart for Fluopyram for the period 8-12-2021 → 30-6-2022



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,006	88,6	0,00216		0,0022	8,1	0,0081	28		13		0,01	0,05

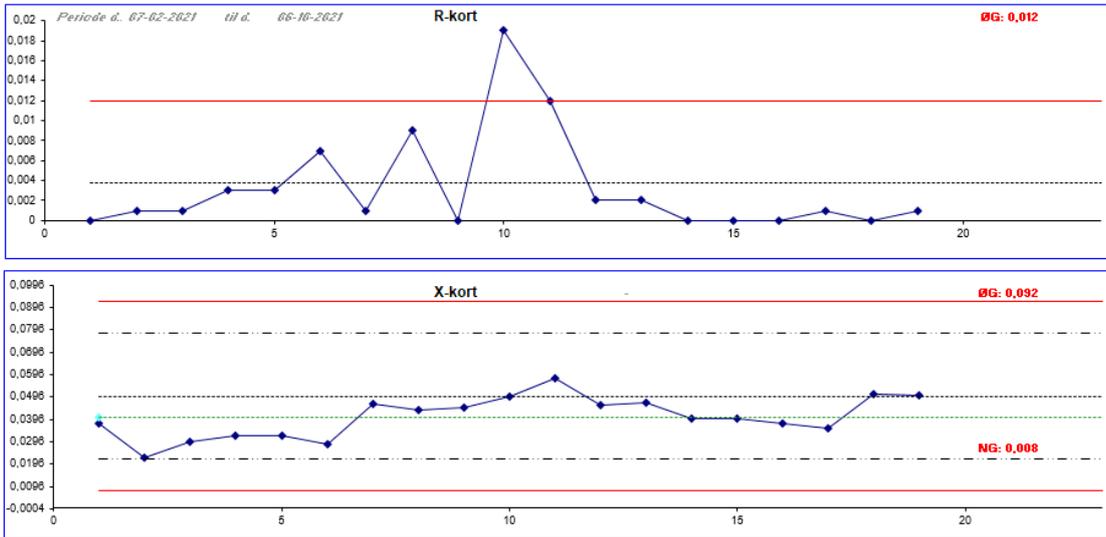
Evaluerings bemærkninger (ctrl-e) :

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 25-03-2022 til d. 27-06-2022  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 13  
 Antal udeladte Ingen

Figure A6.21. QC chart for Fluopyram-7-hydroxy.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	81,5	0,00419	0,00860	0,0096	23,5	0,027	61		19		0,01	0,05

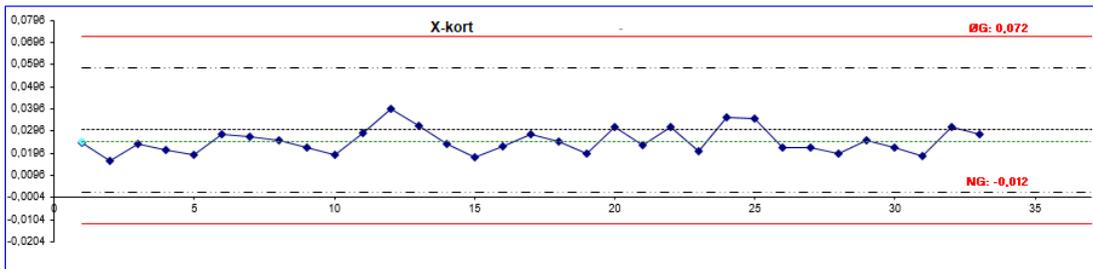
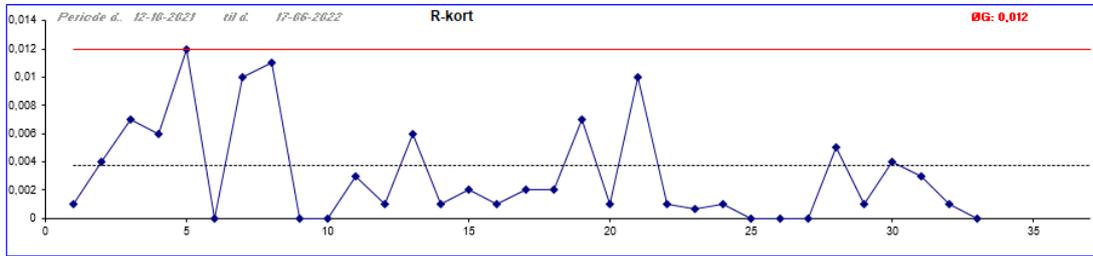
Evaluerings bemærkninger (ctrl-e) :

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 07-02-2021 til d. 06-10-2021  
 Evalueringsperiode 01-07-2020 til 06-10-2021  
 Antal punkter 19  
 Antal udeladte Ingen

Figure A6.22. QC chart for IN-B5528 for the period 1-7-2020 → 6-10-2021.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	83,6	0,00333	0,00517	0,0062	24,5	0,016	59		33		0,01	0,05

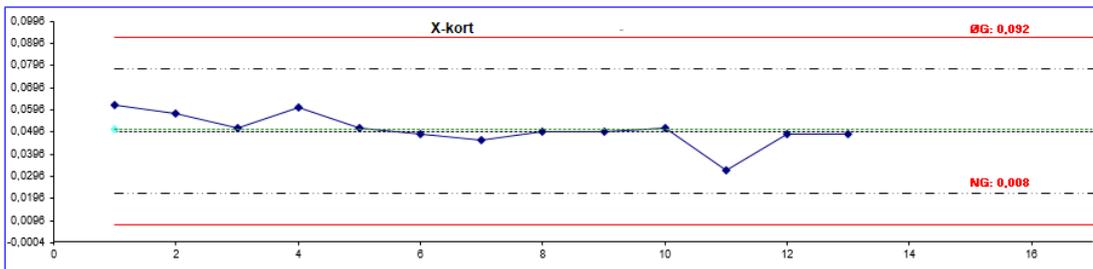
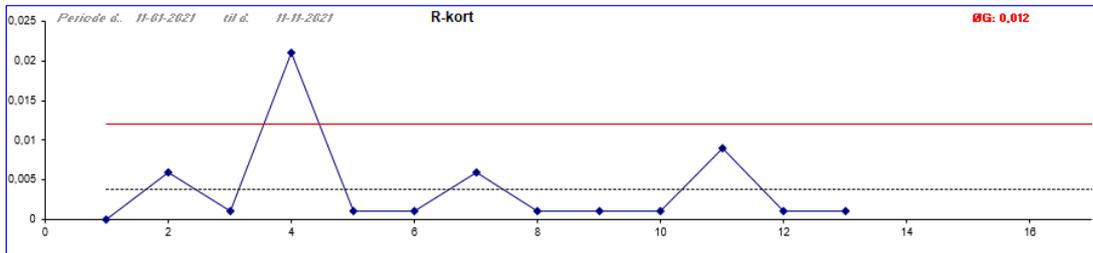
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 12-10-2021 til d.: 17-06-2022  
 Evalueringsperiode 07-10-2021 til 30-06-2022  
 Antal punkter 33  
 Antal udeladte Ingen

Figure A6.23. QC chart for IN-B5528 for the period 7-10-2021 → 30-6-2022.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	101,2	0,00481	0,00652	0,0081	16,0	0,017	33		13		0,01	0,05

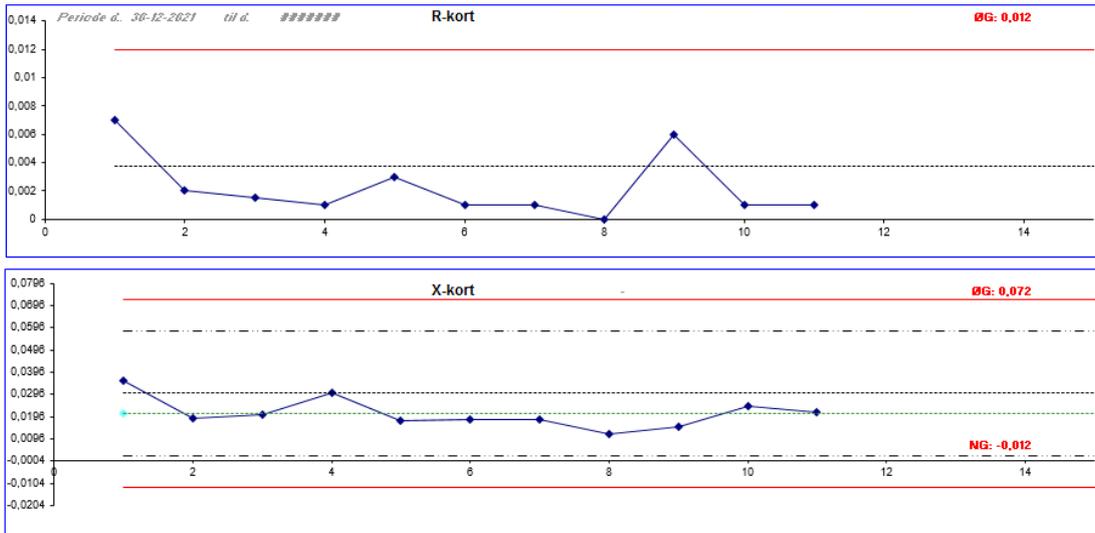
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 11-01-2021 til d.: 11-11-2021  
 Evalueringsperiode 01-07-2020 til 26-11-2021  
 Antal punkter 13  
 Antal udeladte Ingen

Figure A6.24. QC chart for IN-JZ789 for the period 1-7-2020 → 26-11-2021.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD
S	0,007	70,5	0,00219	0,00660	0,0069	32,8	0,023	90	11			0,01

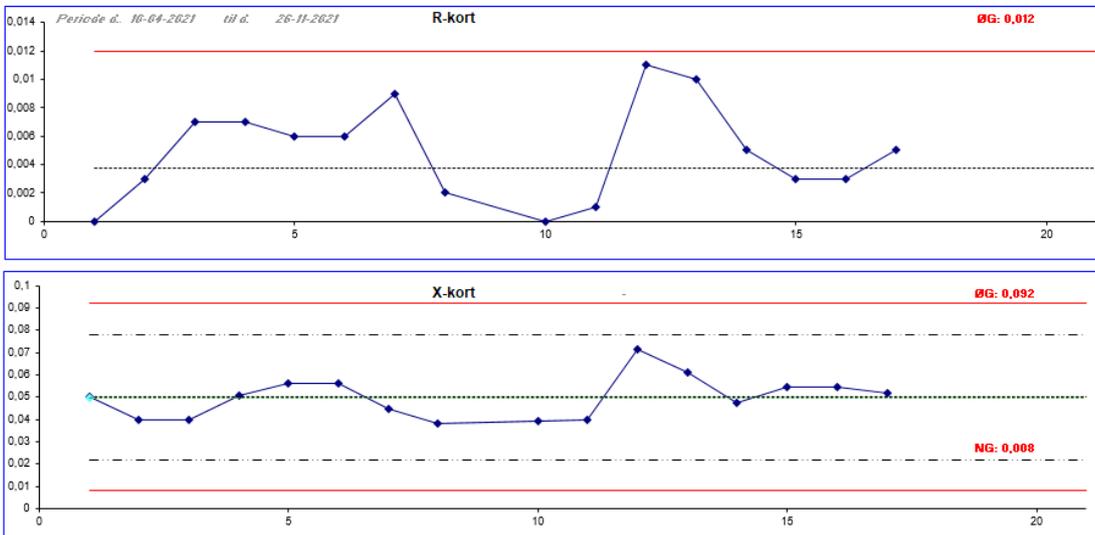
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n-næste

Periode d.: 30-12-2021 til d.: 05-06-2022  
 Evalueringsperiode 30-12-2021 til 30-12-2023  
 Antal punkter 11  
 Antal udeladte Ingen

Figure A6.25. QC chart for IN-JZ789 for the period 30-12-2021 → 5-6-2022.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD
S	0,01	99,1	0,00416	0,00894	0,0099	19,9			1	16		0,01

Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n-næste

Periode d.: 10-04-2021 til d.: 26-11-2021  
 Evalueringsperiode 01-07-2020 til 26-11-2021  
 Antal punkter 16  
 Antal udeladte 1

Figure A6.26. QC chart for IN-L9223 for the period 1-7-2020 → 26-11-2021.

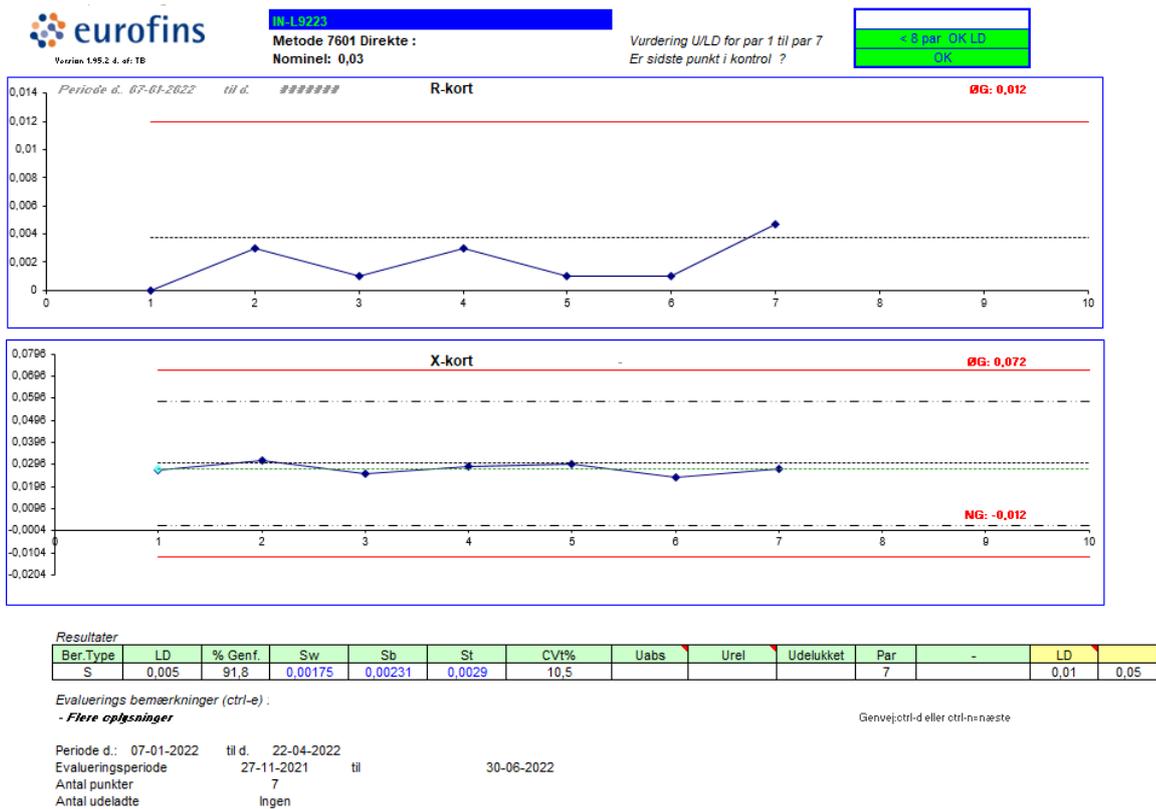


Figure A6.27. QC chart for IN-L9223 for the period 27-11-2021 → 30-6-2022.

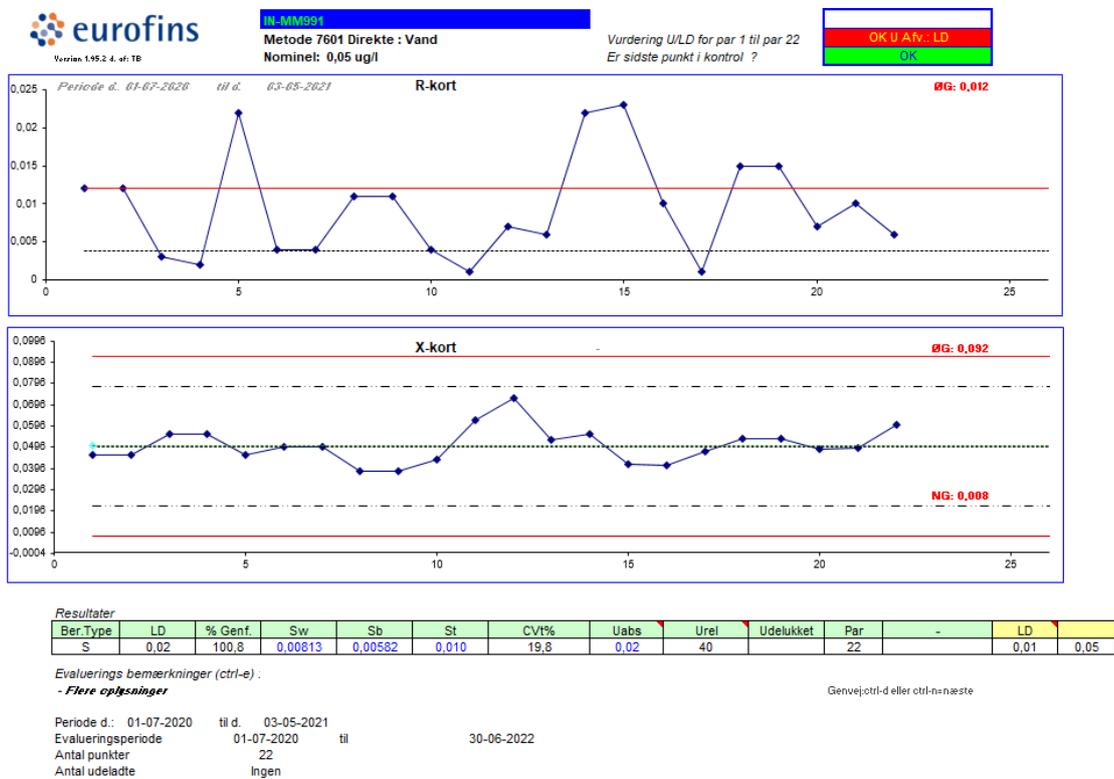
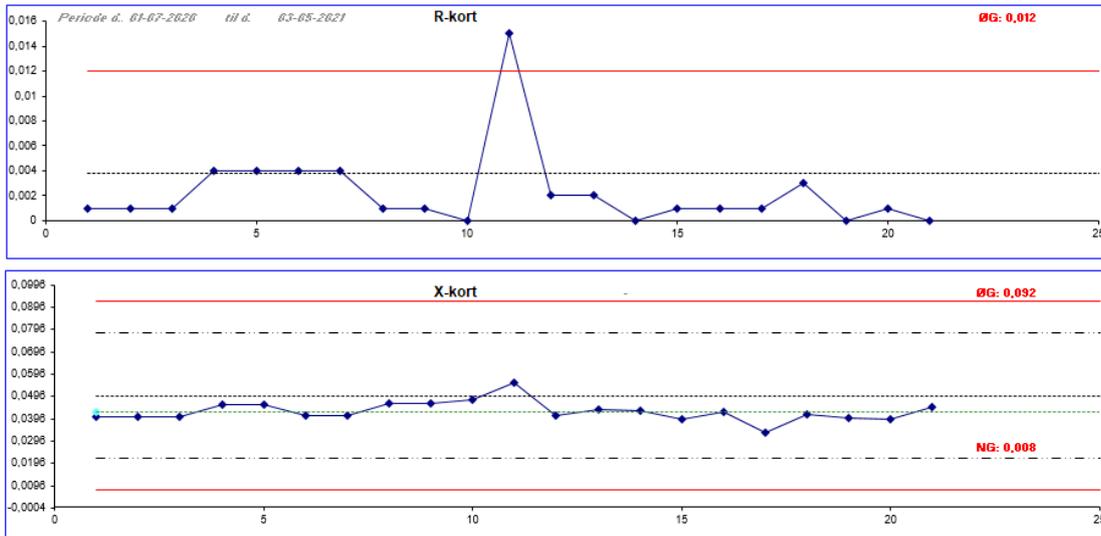


Figure A6.28. QC chart for IN-MM991. The detection limit threshold is exceeded, but the method sensitivity is acceptable. The deviation between pairs is too high, but to decrease the deviation, an internal standard (eg. Deuterium labelled IN-MM991) is necessary. This standard is unfortunately not commercially available. All other internal QC's (blanks) are acceptable and IN-MM991 was not detected in any real samples.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVI%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,008	85,9	0,00274	0,00394	0,0048	11,2	0,017	36		21		0,01	0,05

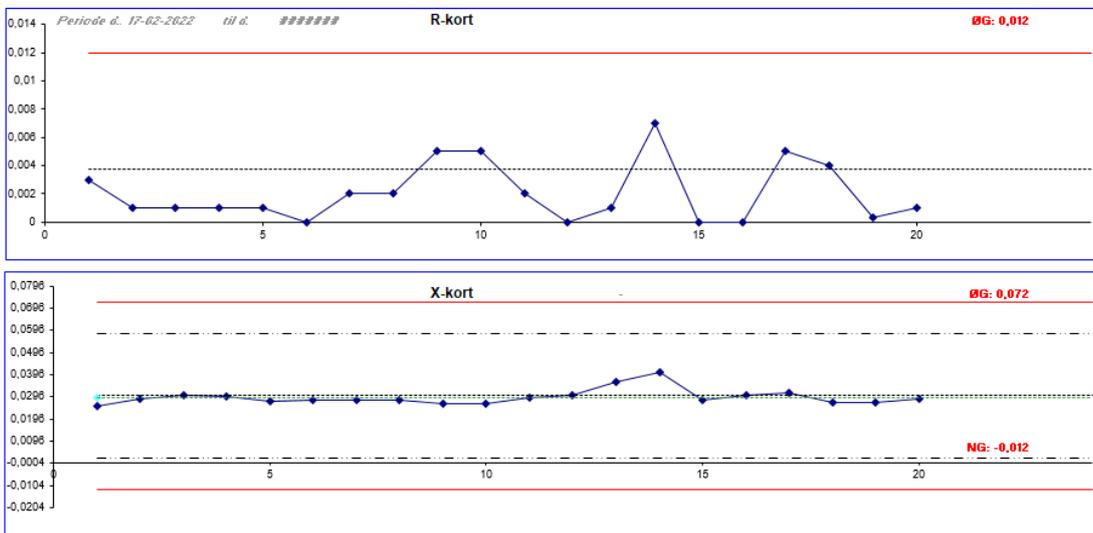
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 01-07-2020 til d. 03-05-2021  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 21  
 Antal udeladte Ingen

Figure A6.29. QC chart for IN-MM671.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVI%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,006	97,8	0,00204	0,00321	0,0038	13,0	0,0079	27		20		0,01	0,05

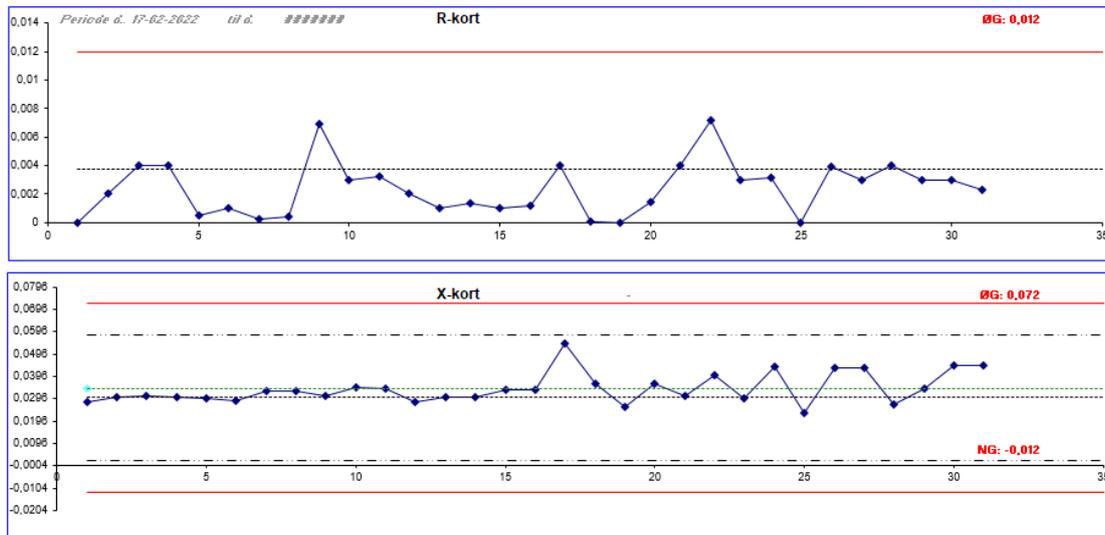
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 17-02-2022 til d. 30-06-2022  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 20  
 Antal udeladte Ingen

Figure A6.30. QC chart for IN-R9805.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,006	113,6	0,00213	0,00669	0,0070	20,6	0,016	50		31		0,01	0,05

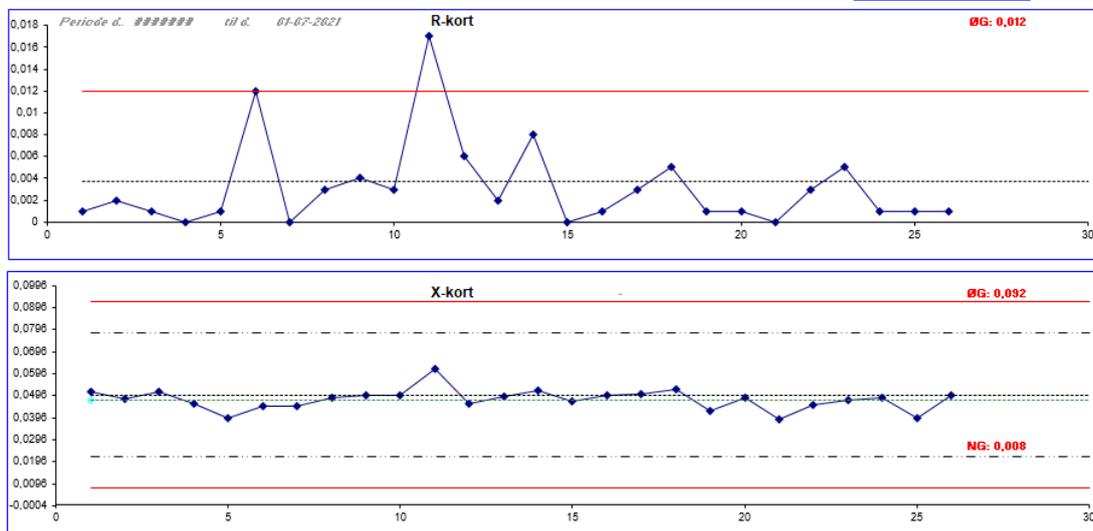
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 17-02-2022 til d. 27-06-2022  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 31  
 Antal udeladte Ingen

Figure A6.31. QC chart for M2.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	95,6	0,00354	0,00397	0,0053	11,1	0,012	24		26		0,01	0,05

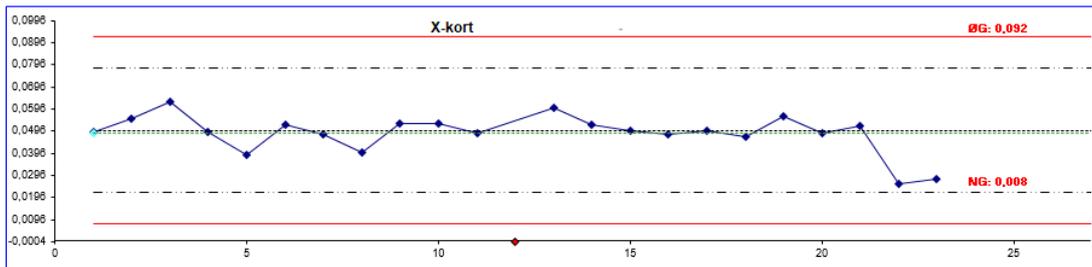
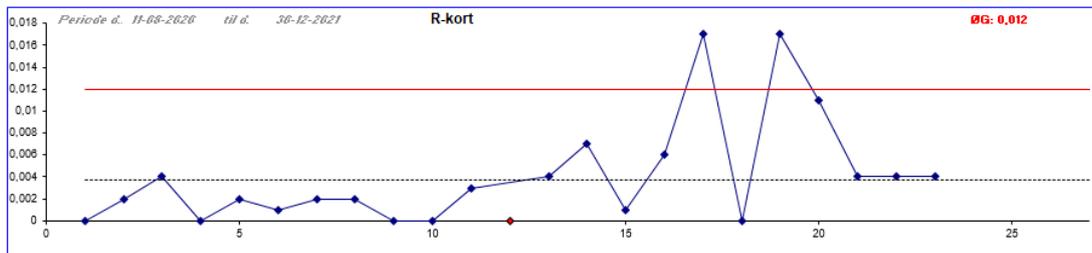
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvej ctrl-d eller ctrl-n næste

Periode d.: 08-07-2020 til d. 01-07-2021  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 26  
 Antal udeladte Ingen

Figure A6.32. QC chart for metconazole.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	97	0,00450	0,00821	0,0094	19,3	0,019	40	1	22	-	0,01	0,05

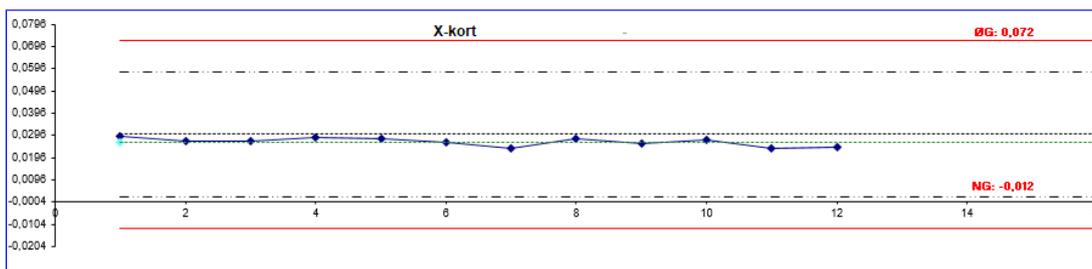
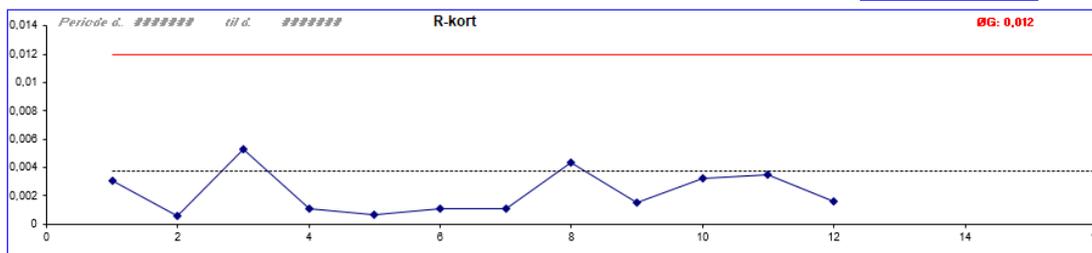
Evalueringens bemærkninger (ctrl-e):

- Flere oplysninger

Genevejctrl-d eller ctrl-n-næste

Periode d.: 11-08-2020 til d. 30-12-2021  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 22  
 Antal udeladte 1

Figure A6.33. QC chart for picloram.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CV1%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,006	88,6	0,00193	0,00139	0,0024	8,9	0,0084	29		12	-	0,01	0,05

Evalueringens bemærkninger (ctrl-e):

- Flere oplysninger

Genevejctrl-d eller ctrl-n-næste

Periode d.: 25-03-2022 til d. 27-06-2022  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 12  
 Antal udeladte Ingen

Figure A6.34. QC chart for propyzamid.

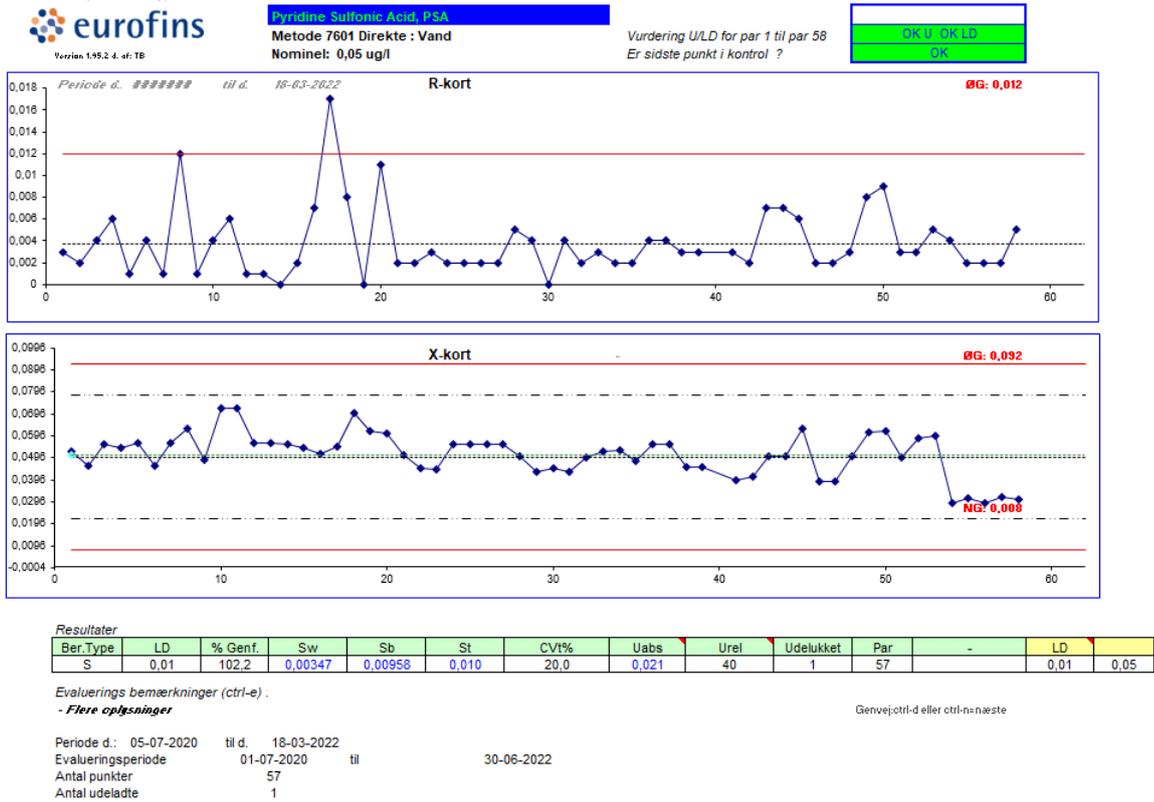


Figure A6.35. QC chart for PSA (2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonic acid).

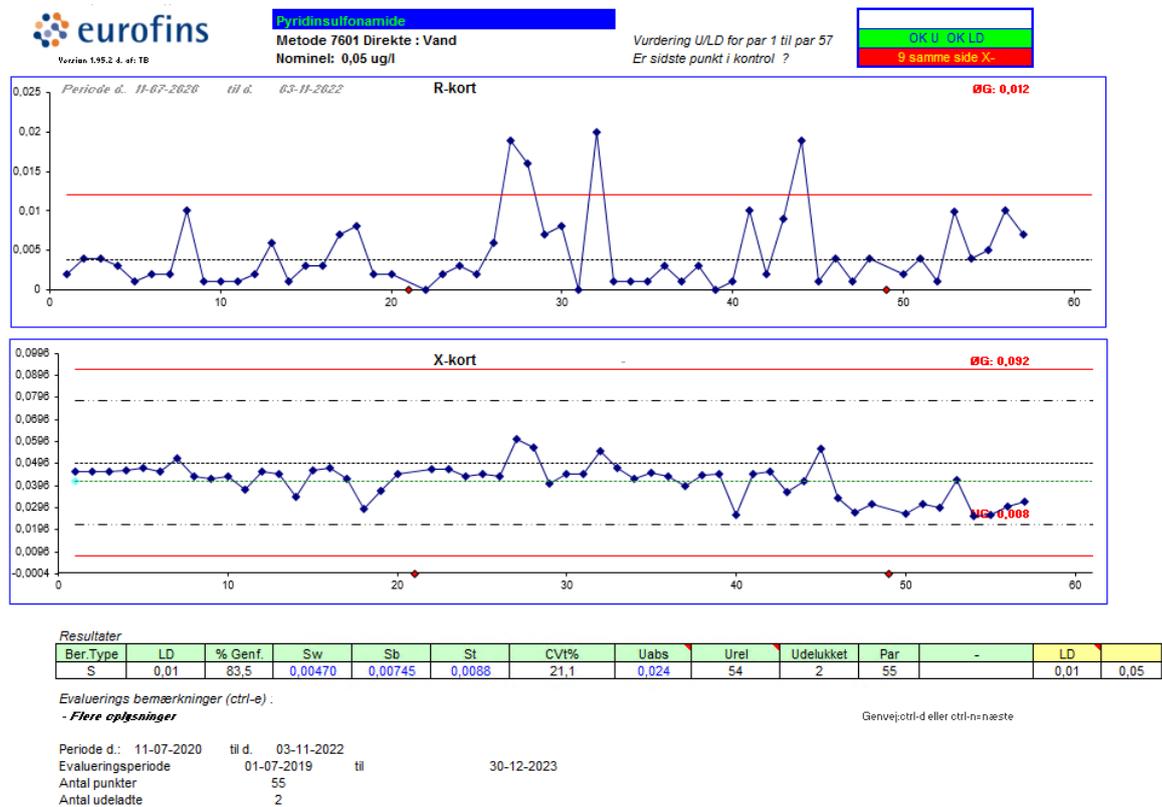
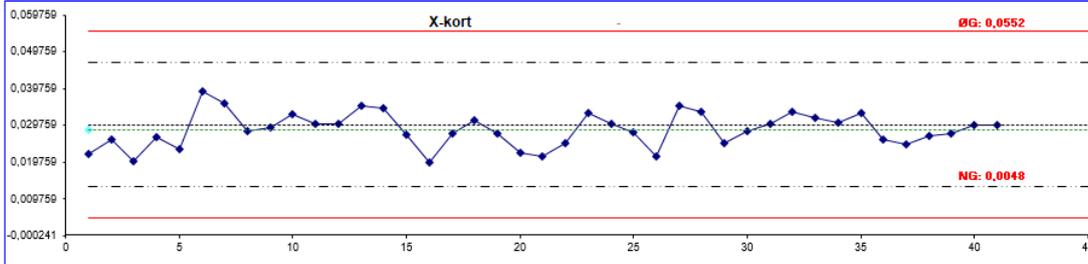
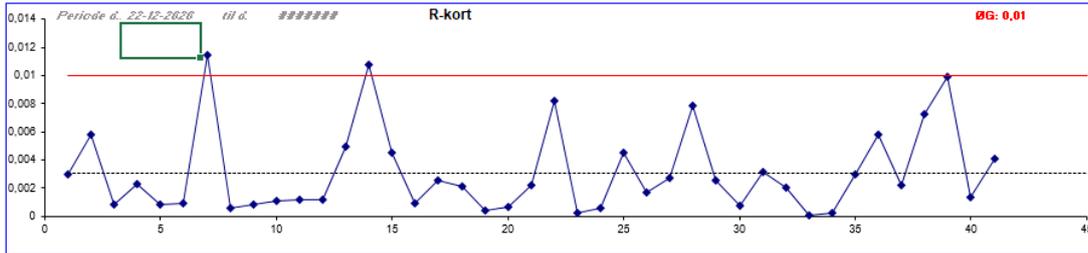


Figure A6.36. QC chart for pyridine sulfonamide.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,009	95,4	0,00304	0,00410	0,0051	17,8	0,011	37	41			0,05	0,25

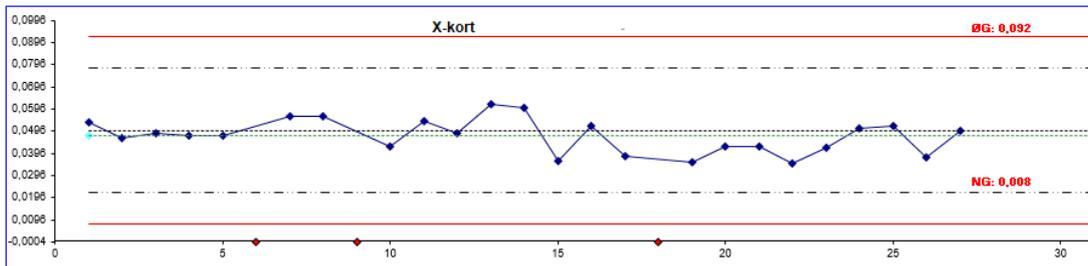
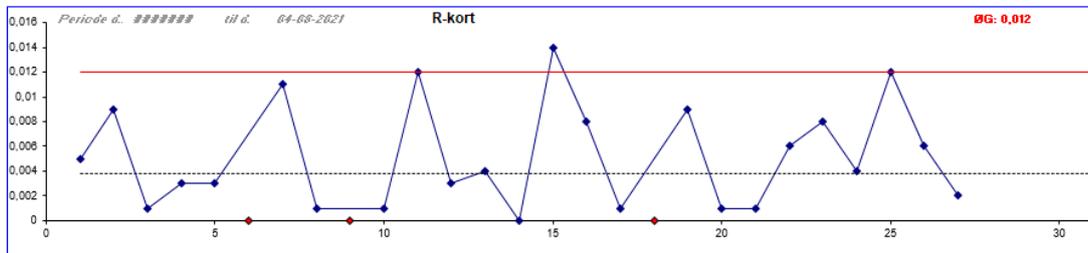
Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 22-12-2020 til d.: 09-03-2022  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 41  
 Antal udeladte Ingen

Figure A6.37. QC chart TSA.



Resultater

Ber.Type	LD	% Genf.	Sw	Sb	St	CVt%	Uabs	Urel	Udelukket	Par	-	LD	
S	0,01	94,9	0,00470	0,00699	0,0084	17,8	0,018	37	3	24		0,01	0,05

Evaluerings bemærkninger (ctrl-e):

- Flere oplysninger

Genvejctrl-d eller ctrl-n næste

Periode d.: 08-07-2020 til d.: 04-08-2021  
 Evalueringsperiode 01-07-2020 til 30-06-2022  
 Antal punkter 24  
 Antal udeladte 3

Figure A6.38. QC chart X-729.

**Appendix 7**

**Pesticides analysed at five PLAP fields in the period up to 2020**

**Table A7.1A.** Pesticides analysed at **Tylstrup** with the products used shown in parentheses. Degradation products are in italics. Precipitation (prec.) and percolation (perc.) are accumulated from the date of first application until the end of monitoring. 1<sup>st</sup> month perc. refers to accumulated percolation within the first month after the application. C<sub>mean</sub> refers to average leachate concentration at 1 mbgs the first year after application. (See Appendix 2 for calculation method).

Crop and analysed pesticides	Application date	End of monitoring	Prec. (mm)	Perc. (mm)	1 <sup>st</sup> month perc. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Potatoes 1999</b>						
Linuron (Afalon)	May 99	Jul 01	2550	1253	87	<0.01
- <i>ETU</i> <sup>1)</sup> (Dithane DG)	Jun 99	Oct 01	2381	1169	73	<0.01
Metribuzine (Sencor WG)	Jun 99	Jul 03	4223	2097	85	<0.01
- <i>metribuzine-diketo</i>		Jul 10 <sup>†</sup>	11142	5387	85	0.05–0.36
- <i>metribuzine-desamino</i>		Jul 03	4223	2097	85	<0.02
- <i>metribuzine-desamino-diketo</i>		Apr 08	8689	4192	85	0.14–0.97
<b>Spring barley 2000</b>						
Triasulfuron (Logran 20 WG)	May 00	Apr 03	2740	1283	13	<0.02
- <i>triazinamin</i>						<0.02
Propiconazole (Tilt Top)	Jun 00	Jul 03	2948	1341	11	<0.01
Fenpropimorph (Tilt Top)	Jun 00	Jul 03	2948	1341	11	<0.01
- <i>fenpropimorphic acid</i>						<0.02
Pirimicarb (Pirimor G)	Jun 00	Apr 03	2622	1263	17	<0.01
- <i>pirimicarb-desmethyl</i>						<0.02
- <i>pirimicarb-desmethyl-formamido</i>						<0.02
<b>Winter rye 2001</b>						
Pendimethalin (Stomp SC)	Nov 00	Apr 03	2271	1219	109	<0.01
<i>Triazinamin-methyl</i> <sup>2)</sup> (Express)	Nov 00	Apr 03	2271	1219	109	<0.02
Propiconazole (Tilt Top)	May 01	Jul 03	2948	1341	11	<0.01
Fenpropimorph (Tilt Top)	May 01	Jul 03	2948	1341	11	<0.01
- <i>fenpropimorphic acid</i>						<0.01
<b>Winter rape 2002</b>						
Clomazone (Command CS)	Sep 01	Jul 04	2534	1194	9	<0.01
- <i>FMC 65317 (propanamide-cloma-zone)</i>						<0.02
<b>Winter wheat 2003</b>						
Bromoxynil (Oxitril CM)	Oct 02	Apr 05	2082	995	53	<0.01
loxylinil (Oxitril CM)	Oct 02	Apr 05	2082	995	53	<0.01
Fluroxypyr (Starane 180)	May 03	Jul 05	1867	787	50	<0.02
Flamprop-M-isopropyl (Barnon Plus 3)	May 03	Jul 05	2635	1031	42	<0.01
- <i>Flamprop-M (free acid)</i>						<0.01
Dimethoate (Perfekthion 500 S)	Jul 03	Jul 05	1629	722	14	<0.01
<b>Potatoes 2004</b>						
- <i>Fluazifop-P (free acid)</i> <sup>3)</sup>	May 04	Jul 06	1754	704	16	<0.01
(Fusilade X-tra)						
Rimsulfuron (Titus)	Jun 04	Jul 06	6211	3008	13	<0.02
- <i>PPU</i> <sup>4)</sup> (Titus)	Jun 04	Jul 10 <sup>†</sup>	6211	3008	13	<0.01 <sup>5)</sup>
- <i>PPU-desamino</i> <sup>4)</sup> (Titus)	Jun 04	Jul 10 <sup>†</sup>	6211	3008	13	<0.01 <sup>5)</sup>
<b>Maize 2005</b>						
Terbuthylazine (Inter-Terbuthylazine)	May 05	Jul 07	2145	933	16	<0.01
- <i>desethyl-terbuthylazine</i>						<0.01
- <i>2-hydroxy-terbuthylazine</i>						<0.01
- <i>desisopropyl-atrazine</i>						<0.01 <sup>6)</sup>
- <i>2-hydroxy-desethyl-terbuthylazine</i>						<0.01
Bentazone (Laddok TE)	Jun 05	Jul 07	2061	927	33	<0.01
- <i>AIBA</i>						<0.01
<b>Spring barley 2006</b>						
- <i>triazinamin-methyl</i> <sup>7)</sup> (Express ST)	Jun 06	Jul 08	2349	1184	43	<0.02
Epoxiconazole (Opus)	Jun 06	Jul 08	2233	1148	24	<0.01

Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1.

<sup>1)</sup> Degradation product of mancozeb. The parent compound degrades too rapidly to be detected by monitoring.

<sup>2)</sup> Degradation product of tribenuron-methyl. The parent compound degrades too rapidly to be detected by monitoring.

<sup>3)</sup> Degradation product of fluazifop-P-butyl. The parent compound degrades too rapidly to be detected by monitoring.

<sup>4)</sup> Degradation product of rimsulfuron. The parent compound degrades too rapidly to be detected by monitoring.

<sup>5)</sup> Leaching increased in the second and third year after application.

<sup>6)</sup> Leaching increased during the second year after application but measured concentrations did not exceed 0.042 µg/L (see Kjær et al., 2008).

<sup>7)</sup> Degradation product of tribenuron-methyl. The parent compound degrades too rapidly to be detected by monitoring.

**Table A7.1B.** Pesticides analysed at **Tylstrup**. For each pesticide (P) and degradation product (M) the application date (appl. date) as well as end of monitoring period (End mon.) is listed. Precipitation and percolation are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method and Appendix 8 (Table A8.1) for previous applications of pesticides.

Crop	Applied product	Analysed pesticide /degradation product	Appl. date	End mon.	Y 1 <sup>st</sup> precip.	Y 1 <sup>st</sup> percol.	M 1 <sup>st</sup> precip.	M 1 <sup>st</sup> percol.	C <sub>mean</sub>	
<b>Winter Rape 2007</b>	CruiserRAPS	Thiamethoxam(P)	Aug 06	Apr 08	1250	700	87	57	<0.01	
		CGA 322704(M)	Aug 06	Apr 08	1250	700	87	57	<0.02	
	Kerb 500 SC	Propyzamide(P)	Feb 07	Apr 09	1052	472	48	40	<0.01	
		RH-24580(M)	Feb 07	Apr 09	1052	472	48	40	<0.01	
		RH-24644(M)	Feb 07	Apr 09	1052	472	48	40	<0.01	
		RH-24655(M)	Feb 07	Apr 09	1052	472	48	40	<0.01	
Matrigan	Clopyralid(P)	Mar 07	Apr 09	1055	488	30	24	<0.02		
<b>Winter wheat 2008</b>	Amistar	Azoxystrobin(P)	Jun 08	Jun 11	1316	662	141	0	<0.01	
		CyPM(M)	Jun 08	Jun 11	1316	662	141	0	<0.01	
	Folicur EC 250	Tebuconazole(P)	Nov 07	Mar 10	1133	461	69	43	<0.01	
	Stomp	Pendimethalin(P)	Oct 07	Dec 09	1032	415	36	26	<0.01	
<b>Spring barley 2009</b>	Amistar	Azoxystrobin(P)	Jun 09	Jun 11	909	475	138	11	<0.01	
		CyPM(M)	Jun 09	Jun 11	909	475	138	11	<0.01	
	Basagran M75	Bentazone(P)	May 09	Jun 12	996	488	133	22	<0.01	
<b>Potatoes 2010</b>	Fenix	Aclonifen(P)	May 10	Jun 12	958	491	62	12	<0.01	
	Titus WSB	PPU(M)	May 10	Dec 12	958	491	62	12	0.01-0.02*	
		PPU-desamino(M)	May 10	Dec 12	958	491	62	12	<0.01	
	Ranman	Cyazofamid(P)	Jun 10	Jun 12	981	499	128	17	<0.01	
	Ridomil Gold MZ Pepite	Metalaxyl-M(P)	Jul 10	Mar 15	934	514	127	43	<0.01	
		CGA 108906(M)	Jul 10	Mar 15	934	514	127	43	0.03-0.12*	
		CGA 62826(M)	Jul 10	Mar 15	934	514	127	43	<0.01-0.02*	
<b>Spring barley 2011</b>	Bell	Boscalid(P)	Jun 11	Dec 12	959	467	106	20	<0.01	
<b>Spring barley 2012</b>	Fox 480 SC	Bifenox(P)	May 12	Dec 12	803	338	100	23	<0.02	
		Bifenox acid(M)	May 12	Dec12	803	338	100	23	<0.05	
		Nitrofen(M)	May 12	Dec12	803	338	100	23	<0.01	
	Mustang forte	Aminopyralid(P)	May 12	Apr 15	852	335	121	22	<0.02	
<b>Winter rye 2013</b>	Boxer	Prosulfocarb(P)	Oct 12	Mar 15	507	285	79	49	<0.01	
<b>Potatoes 2014</b>	Maxim 100 FS Fludioxonil (P)	CGA 339833 (M)	Apr 14	Mar 16	1178	699	86	17	<0.03	
		CGA 192155 (M)	Apr 14	Mar 16	1178	699	86	17	<0.01	
	Dithane NT	EBIS (M)		Jun 14	Mar 15	1134	654	93	34	<0.02
	Mancozeb (P)									

\*Difference between S1 and S2.

**Table A7.1B (continued).** Pesticides analysed at Tylstrup. Precipitation (precip.) and percolation (percol.) are accumulated within the first year (Y 1<sup>st</sup>), and month (M 1<sup>st</sup>) after application. C<sub>mean</sub> is average leachate concentration at 1 mbgs. See Appendix 2 for calculation method and Appendix 7 (Table A7.1) for previous applications of pesticides.

Crop – Year of harvest	Applied Product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of monitoring	Y 1 <sup>st</sup> precip. (mm)	Y 1 <sup>st</sup> percol. (mm)	M 1 <sup>st</sup> precip. (mm)	M 1 <sup>st</sup> percol. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Winter wheat 2015</b>	Orius 200 EW Tebuconazole (P)	1,2,4-triazole (M)	Nov 14	Jun 18	1045	467	105	80	x
	Proline EC 250 Prothioconazole (P)	1,2,4-triazole (M)	May 15	Jun 18	1060	504	76	9	x
<b>Spring barley 2016</b>	Fighter 480 Bentazone (P)	Bentazone (P)	May 16	Apr 18	935	464	132	23	<0.01
		6-hydroxy-bentazone (M)	May 16	Apr 18	935	464	132	23	<0.01
		8-hydroxy-bentazone (M)	May 16	Apr 18	935	464	132	23	<0.01
		N-methyl-bentazone (M)	May 16	Apr 18	935	464	132	23	<0.01
<b>Spring barley 2017</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Hussar Plus OD Mesosulfuron- methyl- Na (P)	AE F099095 (M)	May 17	Dec 18	1221	673	110	16	<0.01
		AE F160459 (M)	May 17	Dec 18	1221	673	110	16	<0.01
	Bumper 25 BC* Propiconazole (P)	1,2,4-triazole (M)	Jun 17	Dec 18	1337	682	171	26	x
<b>Winter barley 2018</b>	Standby								
<b>Spring oats 2019</b>	Standby								
<b>Spring barley 2020</b>	Standby								
<b>Spring barley 2021</b>	Standby								
<b>Spring barley 2022</b>	Standby								

Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1. SD = Seed dressing.

\* Application both 1<sup>st</sup> June and 14<sup>th</sup> June.

x Due to a high background content of 1,2,4-triazole, the results of the analysis cannot be linked directly to the specific application, why C<sub>mean</sub> is not presented.

**Table A7.2A.** Pesticides analysed at **Jyndevad** with the product used shown in parentheses. Degradation products are in italics. Precipitation (prec.) and percolation (perc.) are accumulated from date of first application until end of monitoring. 1<sup>st</sup> month perc. refers to accumulated percolation within the first month after application.  $C_{\text{mean}}$  refers to average leachate concentration 1 m below the first year after application. (See Appendix 2 for calculation method).

Crop and analysed pesticides	Application date	End of monitoring	Prec. (mm)	Perc. (mm)	1 <sup>st</sup> month perc. (mm)	$C_{\text{mean}}$ ( $\mu\text{g L}^{-1}$ )
<b>Winter rye 2000</b>						
Glyphosate (Roundup 2000)	Sep 99	Apr 02	2759	1607	139	<0.01
- AMPA						<0.01
<i>Triazinamin-methyl<sup>1)</sup></i> (Express)	Nov 99	Apr 02	2534	1451	86	<0.02
Propiconazole (Tilt Top)	Apr 00	Jul 02	2301	1061	3	<0.01
Fenpropimorph (Tilt Top)	Apr 00	Apr 02	2015	1029	3	<0.01
- <i>fenpropimorphic acid</i>						<0.01
<b>Maize 2001</b>						
Terbuthylazine (Lido 410 SC)	May 01	Apr 04	3118	1809	4	<0.01
- <i>desethyl-terbuthylazine</i>	May 01	Apr 07	6742	3826	4	<0.01-0.02
PHCP <sup>2)</sup> (Lido 410 SC)	May 01	Jul 03	2413	1366	4	<0.02
<b>Potatoes 2002</b>						
- PPU (Titus) <sup>3)</sup>	May 02	Jul 10 <sup>†</sup>	9389	5126	11	0.06 <sup>4)</sup> -
- PPU- <i>desamino</i> (Titus) <sup>3)</sup>		Jul 10 <sup>†</sup>	9389	5126	11	0.13
<b>Spring barley 2003</b>						
MCPA (Metaxon)	Jun 03	Jul 05	2340	1233	0	<0.01
- <i>4-chlor,2-methylphenol</i>						<0.01
Dimethoate (Perfekthion 500 S)	Jun 03	Jul 05	2278	1232	1	<0.01
<b>Pea 2004</b>						
Bentazone (Basagran 480)	May 04	Jul 07	3888	2044	4	0.02-0.13
- AIBA						<0.01
Pendimethalin (Stomp SC)	May 04	Apr 07	3557	1996	4	<0.01
Pirimicarb (Pirimor G)	Jun 04	Apr 07	3493	1993	27	<0.01
- <i>Pirimicarb-desmethyl</i>						<0.01
- <i>Pirimicarb-desmethyl-formamido</i>						<0.02
- <i>fluazifop-P(free acid)<sup>5)</sup></i>	Jun 04	Jul 06	2395	1233	27	<0.01
(Fusilade X-tra)						
<b>Winter wheat 2005</b>						
loxynil (Oxitril CM)	Oct 04	Apr 07	2955	1791	81	<0.01
Bromoxynil (Oxitril CM)	Oct 04	Apr 07	2955	1791	81	<0.01
Amidosulfuron (Gratil 75 WG)	Apr 05	Jul 07	1070	515	33	<0.01
Fluroxypyr (Starane 180 S)	May 05	Jul 07	2683	1360	37	<0.02
Azoxystrobin (Amistar)	May 05	Apr 07	2274	1283	49	<0.01
- CyPM						<0.02
<b>Spring barley 2006</b>						
Florasulam (Primus)	May 06	Jul 08	2779	1487	34	<0.01
- <i>florasulam-desmethyl</i>						<0.03
Epoxiconazole (Opus)	Jun 06	Dec 09	4698	2592	31	<0.01

Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1.

<sup>1)</sup> Degradation product of tribenuron-methyl. The parent compound degrades too rapidly to be detected by monitoring.

<sup>2)</sup> Degradation product of pyridate. The parent compound degrades too rapidly to be detected by monitoring.

<sup>3)</sup> Degradation product of rimsulfuron. The parent compound degrades too rapidly to be detected by monitoring.

<sup>4)</sup> Leaching increased the second year after application.

<sup>5)</sup> Degradation product of fluazifop-P-butyl. The parent compound degrades too rapidly to be detected by monitoring.

**Table A7.2B.** Pesticides analysed at **Jyndeivad**. For each compound it is listed whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop	Applied product	Analysed pesticide /degradation product	Appl. date	End mon.	Y 1 <sup>st</sup> precip.	Y 1 <sup>st</sup> percol.	M 1 <sup>st</sup> precip.	M 1 <sup>st</sup> percol.	C <sub>mean</sub>
<b>Triticale 2007</b>	Atlantis WG	Mesosulfuron-methyl(P)	Oct 06	Dec 09	1346	809	95	73	<0.01
		Mesosulfuron(M)	Oct 06	Dec 09	1346	809	95	73	<0.02
	Cycocel 750	Chlormequat(P)	Apr 07	Jun 08	1223	638	79	1	<0.01
	Opus	Epoxiconazole(P)	May 07	Dec 09	1193	644	123	6	<0.01
<b>Winter wheat 2008</b>	Folicur EC 250	Tebuconazole(P)	Dec 07	Mar 10	1396	827	60	97	<0.01
	Pico 750 WG	Picolinafen(P)	Oct 07	Mar 10	1418	777	77	55	<0.01
	Pico 750 WG	CL 153815(M)	Oct 07	Mar 10	1418	777	77	55	<0.01
<b>Spring barley 2009</b>	Basagran M75	Bentazone(P)	May 09	Jun 12	1178	630	144	13	<0.01-0.04 <sup>*</sup>
	Bell	Epoxiconazole(P)	May 09	Dec 09	1181	630	164	42	<0.01
	Fox 480 SC	Bifenox(P)	Apr 09	Jun 12	1206	630	106	3	<0.02
	Fox 480 SC	Bifenox acid(M)	Apr 09	Jun 12	1206	630	106	3	<0.05
	Fox 480 SC	Nitrofen(M)	Apr 09	Jun 12	1206	630	106	3	<0.01
<b>Potatoes 2010</b>	Fenix	Aclonifen(P)	May 10	Jun 13	1149	567	123	10	<0.01
	Ranman	Cyazofamid(P)	Jun 10	Jun 12	1188	627	125	16	<0.01
	Titus WSB	PPU(M)	Jun 10	Jun 12	1160	592	137	13	0.02
		PPU-desamino(M)	Jun 10	Jun 12	1160	592	137	13	<0.01
	Ridomil Gold	Metalaxyl-M(P)	Jul 10	Mar 15	1073	613	161	41	0.02
	MZ Pepite	CGA 108906(M)	Jul 10	Mar 15	1073	613	161	41	0.37-0.6 <sup>**</sup>
CGA 62826(M)		Jul 10	Mar 15	1073	613	161	41	0.16-0.19 <sup>**</sup>	
<b>Spring barley 2011</b>	DFF	Diflufenican(P)	Apr 11	Jun 13	1315	742	126	3	<0.01
		AE-05422291(M)	Apr 11	Jun 13	1315	742	126	3	<0.01
		AE-B107137(M)	Apr 11	Jun 13	1315	742	126	3	<0.01
<b>Maize 2012</b>	Callisto	Mesotrione(P)	Jun 12	Mar 15	993	512	109	11	<0.01
	Callisto	AMBA(M)	Jun 12	Mar 15	993	512	109	11	<0.01
	Callisto	MNBA(M)	Jun 12	Mar 15	993	512	109	11	<0.01
	Fighter 480	Bentazone(P)	May 12	Mar 15	994	513	114	2	0.04-0.22 <sup>1</sup>
<b>Peas 2013</b>	Fighter 480	Bentazone(P) <sup>2</sup>	May 13	Mar 15	1175	703	84	0.2	0.02-0.16 <sup>1</sup>
<b>Potatoes 2014</b>	Command CS Clomazone	Clomazone (P)	Apr 14	Mar 15	1393	855	87	18	<0.01
		FMC 65317 (M)	Apr 14	Mar 15	1393	855	87	18	<0.02
	Maxim 100 FS Fludioxonil	CGA 339833 (M)	Apr 14	Apr 16	1404	856	83	10	<0.03
		CGA 192155 (M)	Apr 14	Apr 16	1404	856	83	10	<0.01
	Dithane NT								
	Mancozeb	EBIS (M)	Jun 14	Mar 15	1407	844	138	37	<0.02

<sup>1</sup>Difference between S1 and S2.<sup>2</sup> Bentazone applied on 7 May and 16 May 2013.

**Table A7.2B (continued).** Pesticides analysed at **Jyndeivad**. For each compound it is listed whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

	Applied Product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of monitoring	Y 1 <sup>st</sup> precip. (mm)	Y 1 <sup>st</sup> percol. (mm)	M 1 <sup>st</sup> precip. (mm)	M 1 <sup>st</sup> percol. (mm)	C <sub>mean</sub> ( $\mu\text{g L}^{-1}$ )
<b>Winter wheat 2015</b>	Lexus 50 WG Flupyr sulfuron-methyl	Flupyr sulfuron-methyl (P)	Oct 14 +Mar 15	Oct 16	1221	670	45	76	<0.01
		IN-KC576 (M)	Oct 14 +Mar 15	Oct 16	1221	670	45	76	<0.01
		IN-KY374 (M)	Oct 14 +Mar 15	Oct 16	1221	670	45	76	<0.01
		IN-JV460 (M)	Oct 14 +Mar 15	Oct 16	1221	670	45	76	<0.01
	Orius 200 EW Tebuconazole Opus	1,2,4-triazole (M)	Nov 14		1253	645	86	35	- <sup>3</sup>
	Proline EC 250 Prothioconazole	1,2,4-triazole (M)	May 15		1323	754	81	10	- <sup>3</sup>
<b>Spring barley 2016</b>	Fighter 480 Bentazone	Bentazone (P)	May 16	Apr 18	1174	633	85	6	0.01
		6-hydroxy-bentazone (M)	May 16	Apr 18	1174	633	85	6	<0.01
		8-hydroxy-bentazone (M)	May 16	Apr 18	1174	633	85	6	<0.01
		N-methyl-bentazone (M)	May 16	Apr 18	1174	633	85	6	<0.01
	Bumper 25 EC Propiconazole <sup>1</sup>	1,2,4-triazole (M)	Jun 16	Jun 18	1171	631	247	112	- <sup>3</sup>
<b>Peas 2017</b>	Fighter 480 Bentazone	Bentazone (P)	May 17	Apr 18	1386	849	148	6	0.35
		6-hydroxy-bentazone (M)	May 17	Apr 18	1386	849	148	6	<0.01
		8-hydroxy-bentazone (M)	May 17	Apr 18	1386	849	148	6	<0.01
		N-methyl-bentazone (M)	May 17	Apr 18	1386	849	148	6	<0.01
	Focus Ultra Cycloxydim	BH 517-T2SO2 (M) E/Z BH 517-TSO (M)	May 17 May 17	Mar 19 Mar 19	1430 1430	866 866	132 132	27 27	<0.01 0.07
<b>Winter wheat 2018</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Lexus 50WG Flupyr sulfuron-methyl	IN-KF311 (M)	Oct 17	Mar 19	1194	650	100	90	<0.01
		IN-JE127 (M) <sup>2</sup>	Oct 17	Mar 19	1194	650	100	90	<0.01
	Hussar Plus OD Mesosulfuron-methyl	AE F099095 (M)	Apr 18	Mar 20	1139	548	90	18	<0.01
		AE F160459 (M)	Apr 18	Mar 20	1139	548	90	18	<0.01
		AE F147447 (M)	Apr 18	Mar 20	1139	548	90	18	<0.01
Topsin WG Thiophanat-methyl	Carbendazim (M)	Jun 18	Oct 20	1089	543	196	82	<0.01	
<b>Winter rye 2019</b> SD: Celeste Formula M (Fludioxonil)	Talius Proquinazid (P)	IN-MM671 (M)	Apr 19	Mar 21	1333	821	86	12	<0.01
		IN-MM991 (M)	Apr 19	Mar 21					
<b>Potatoes 2020</b>	Ranman Top Cyazofamid	CCIM (M)	Jun 20						
		CTCA (M)	Jun 20						
		DMSA (M)	Jun 20						
		N,N-DMS (M)	Jun 20						
	Mospilan SG Acetamiprid	IM-1-4 (M) IM-1-5 (M)	Jun 20 Jun 20						
<b>Winter rye 2021</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)									

	Applied Product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of monitoring	Y 1 <sup>st</sup> precip. (mm)	Y 1 <sup>st</sup> percol. (mm)	M 1 <sup>st</sup> precip. (mm)	M 1 <sup>st</sup> percol. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Spring barley 2022</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Nuance Max 75 WG	IN-B5528 (M)	Apr 22						
	Tribenuron-methyl	IN-R9805 (M)	Apr 22						
	Propulse SE 250	M2 (M)	Apr 22						
	Prothioconazole	1,2,4-triazole (M)	May 22						
	Fluopyram	Fluopyram	May 22						
		Fluopyram-7-hydroxy (M)	May 22						

Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1. SD = Seed dressing.<sup>-1)</sup> Propiconazole applied in half of the maximum allowed dose. <sup>2)</sup> The degradation product IN-JE127 was discontinued due to instability in aqueous solution (Chapter 8). <sup>x)</sup> Due to a high background content of 1,2,4-triazole, the results of the analysis cannot be linked directly to the specific application, and c<sub>mean</sub> is not presented.

**Table A7.3A.** Pesticides analysed at **Silstrup** with the product used shown in parentheses. Degradation products are in italics. Precipitation (prec.) and percolation (perc.) are accumulated from date of first application until end of monitoring. 1<sup>st</sup> month perc. refers to accumulated percolation within the first month after application.  $C_{\text{mean}}$  refers to average leachate concentration in the drainage water within the first drainage season after application. (See Appendix 2 for calculation methods).

Crop and analysed pesticides	Application date	End of monitoring	Prec. (mm)	Perc. (mm)	1 <sup>st</sup> month perc. (mm)	$C_{\text{mean}}$ ( $\mu\text{g L}^{-1}$ )
<b>Fodder beet 2000</b>						
Metamitron (Goltix WG)	May 00	Apr 03	2634	1328	53	0.05
- <i>metamitron-desamino</i>						0.06
Ethofumesate (Betanal Optima)	May 00	Apr 03	2634	1328	53	0.03
Desmedipham (Betanal Optima)	May 00	Apr 03	2634	1328	53	<0.01
- <i>EHPC</i>						<0.02
Phenmedipham (Betanal Optima)	May 00	Apr 03	2634	1328	53	<0.01
- <i>MHPC</i>						<0.02
- <i>3-aminophenol</i>						<0.02
Fluazifop-P-butyl (Fusilade X-tra)	Jun 00	Jul 02	1953	1019	5	<0.01
- <i>fluazifop (free acid)</i>						<0.02
Pirimicarb (Pirimor G)	Jul 00	Jul 07	6452	2825	1	<0.01
- <i>pirimicarb-desmethyl</i>						<0.01
- <i>pirimicarb-desmethyl-formamido</i>						<0.02
<b>Spring barley 2001</b>						
Triazinamin-methyl <sup>1)</sup> (Express)	May 01	Jul 03	1941	951	10	<0.02
Flamprop-M-isopropyl (Barnon Plus 3)	Jun 01	Jul 03	1928	944	3	<0.01
- <i>flamprop (free acid)</i>						<0.01
Propiconazole (Tilt Top)	Jun 01	Jul 03	1928	944	3	<0.01
Fenpropimorph (Tilt Top)	Jun 01	Jul 03	1928	944	3	<0.01
- <i>fenpropimorphic acid</i>						<0.01
Dimethoate (Perfekthion 500 S)	Jul 01	Jul 03	1882	937	3	0.02
<b>Maize 2002</b>						
Glyphosate (Roundup Bio)	Oct 01	Apr 06	3802	1694	44	0.13
- <i>AMPA</i>						0.06
<i>PHCP</i> <sup>2)</sup> (Lido 410 SC)	May 02	Jul 04	1764	738	6	0.06
Terbuthylazine (Lido 410 SC)	May 02	Apr 06	3320	1327	6	0.07
- <i>desethyl-terbuthylazine</i>		Apr 05				0.15
- <i>2-hydroxy-terbuthylazine</i>		Apr 05				<sup>3)</sup>
- <i>2-hydroxy-desethyl-terbuthylazine</i>		Apr 05				<sup>3)</sup>
- <i>desisopropyl-atrazine</i>		Apr 05				<sup>3)</sup>
<b>Peas 2003</b>						
Bentazone (Basagran 480)	May 03	Jul 06	2634	1055	44	0.26
- <i>AIBA</i>						<0.01
Pendimethalin (Storm SC)	May 03	Apr 06	2634	1055	44	<0.01
Glyphosate (Roundup Bio)	Sep 03	Apr 06	2207	971	0	<0.01
- <i>AMBA</i>						0.02
<b>Winter wheat 2004</b>						
Prosulfocarb (Boxer EC)	Oct 03	Apr 06	2125	974	37	0.01
MCPA (Metaxon)	May 04	Jul 06	1797	710	4	<0.01
- <i>4-chlor,2-methylphenol</i>						<0.01
Azoxystrobin (Amistar)	Jun 04	Jul 06	1781	706	0	0.01
- <i>CyPM</i>		Jul 07	2931	1202	0	0.09
Pirimicarb (Pirimor G)	Jul 04	Jul 07	2818	1205	0	<0.01
- <i>Pirimicarb-desmethyl</i>						<0.01
- <i>Pirimicarb-desmethyl-formamido</i>						<0.02
<b>Spring barley 2005</b>						
Fluroxypyr (Starane 180 S)	May 05	Jul 07	2012	830	11	<0.02
Azoxystrobin (Amistar)	Jun 05	Jul 06	862	332	10	0.01
- <i>CyPM</i>	Jun 05	Jul 07	2012	828	10	0.02
Pirimicarb (Pirimor G)	Jul 05	Jul 07	1933	818	0	<0.01
- <i>Pirimicarb-desmethyl</i>						<0.01
- <i>Pirimicarb-desmethyl-formamido</i>						<0.01

**Table A7.3A continued.** Pesticides analysed at **Silstrup** with the product used shown in parentheses. Degradation products are in italics. Precipitation (prec.) and percolation (perc.) are accumulated from date of first application until end of monitoring. 1<sup>st</sup> month perc. refers to accumulated percolation within the first month after application. C<sub>mean</sub> refers to average leachate concentration in the drainage water within the first drainage season after application. (See Appendix 2 for calculation methods).

Crop and analysed pesticides	Application date	End of monitoring	Prec. (mm)	Perc. (mm)	1 <sup>st</sup> month perc. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Winter rape 2006</b>						
Propyzamide (Kerb 500 SC)	Nov 05	Apr 08	2345	1115	75	0.22 <sup>4)</sup>
- <i>RH-24644</i>						0.01 <sup>4)</sup>
- <i>RH-24580</i>						<0.01 <sup>4)</sup>
- <i>RH-24655</i>						<0.01 <sup>4)</sup>
Clopyralid (Matrignon)	Apr 06	Apr 08	2009	859	8	<0.01
<b>Winter wheat 2007</b>						
Chloromequat (Cycocel 750)	Apr 07	Jun 08	966	382	3	<0.01
Iodosulfuron-methyl (Hussar OD)	Apr 07	Oct 10	966	382	3	<0.01
Metsulfuron-methyl (Hussar OD)	Apr 07	Oct 10	966	382	3	<0.01
Epoxiconazole (Opus)	Jun 07	Apr 09	947	407	0	<0.01
Pendimethalin (Stomp Pentagon)	Sep 06	Apr 08	1166	508	0	0.04
<b>Fodder beet 2008</b>						
- <i>Fluazifop-P</i> (Fusilade Max)	Jul 08	Jun 12	985	494	21	<0.01
- <i>TFMP</i> (Fusilade Max)	Jul 08	Jun 12	985	494	21	0.24
Metamitron (Goliath)	May 08	Dec 10	969	498	4	0.01
- <i>Desamino-metamitron</i>	May 08	Dec 10	969	498	4	0.02
Triflusaluron-methyl (Safari)	May 08	Jun 10	969	498	4	<0.01
- <i>IN-D8526</i>	May 08	Jun 10	969	498	4	<0.01
- <i>IN-E7710</i>	May 08	Jun 10	969	498	4	<0.01
- <i>IN-M7222</i>	May 08	Jun 10	969	498	4	<0.02
Ethofumesate (Tramat 500 SC)	May 08	May 10	969	497	3	<0.01

<sup>1)</sup> Degradation product of tribenuron-methyl. The parent compound degrades too rapidly to be detected by monitoring.

<sup>2)</sup> Degradation product of pyridate. The parent compound degrades too rapidly to be detected by monitoring.

<sup>3)</sup> Average leachate concentration within the first drainage season after application could not be calculated, as monitoring started January 2003 (7 months after application). See Kjær et al. (2007) for further information.

<sup>4)</sup> Drainage runoff commenced two weeks prior to the application of propyzamide, and the weighted concentrations refer to the period from the date of application until 1 July 2007.

**Table A7.4B.** Pesticides analysed at **Silstrup**. For each compound it is listed whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop	Applied product	Analysed pesticide /degradation product	Appl. date	End mon.	Y 1 <sup>st</sup> Precip.	Y 1 <sup>st</sup> Percol	M 1 <sup>st</sup> Precip	M 1 <sup>st</sup> Percol	C <sub>mean</sub>
<b>Spring barley 2009</b>	Amistar	Azoxystrobin(P)	Jun 09	Mar 12	835	390	61	0	0.01
		CyPM(M)	Jun 09	Mar 12	835	390	61	0	0.06
<b>Red fescue 2010</b>	Fighter 480	Bentazone(P)	May 09	Jun 11	876	391	85	1	0.03
	Fox 480 SC	Bifenox(P)	Sep 09	Jun 12	888	390	56	0	<0.02
		Bifenox acid(M)	Sep 09	Jun 12	888	390	56	0	2.26
		Nitrofen(M)	Sep 09	Jun 12	888	390	56	0	<0.01
	Fusilade Max	Fluazifop-P(M)	May 10	Jun 12	1027	520	53	2	<0.01
		TFMP(M)	May 10	Jun 12	1027	520	53	2	<0.02
	Hussar OD	Iodosulfuron-methyl(P)	Aug 09	Dec 10	898	390	27	0	<0.01
		Metsulfuron-methyl(M)	Aug 09	Dec 10	898	390	27	0	<0.01
		Triazinamin(M)	Aug 09	Dec 10	898	390	27	0	<0.01
	Hussar OD	Iodosulfuron-methyl(P)	May 10	Dec 10	1024	520	49	1	<0.01
Metsulfuron-methyl(M)		May 10	Dec 10	1024	520	49	1	<0.01	
<b>Red fescue 2011</b>	Fusilade Max	TFMP(M)	May 11	Jun 12	1043	550	26	4	0.003
	Fox 480 SC	Bifenox(P)	Sep 11	Dec 12	989	493	101	68	0.014
		Bifenox acid(M)	Sep 11	Dec 12	989	493	101	68	0.25
		Nitrofen(M)	Sep 11	Dec 12	989	493	101	68	0.03

**Table A7.4B (continued).** Pesticides analysed at **Silstrup**. For each compound it is listed whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop	Applied product	Analysed pesticide /degradation product	Appl. date	End mon.	Y 1 <sup>st</sup> Precip.	Y 1 <sup>st</sup> Percol	M 1 <sup>st</sup> Precip	M 1 <sup>st</sup> Percol	C <sub>mean</sub>	
<b>Red fescue 2012</b>	DFF	Diflufenican(P)	Apr 12	Mar 15	1067	584	112	56	0.009	
		AE-05422291(M)	Apr 12	Mar 15	1067	584	112	56	<0.01	
		AE-B107137(M)	Apr 12	Mar 15	1067	584	112	56	0.007	
	Folicur	Tebuconazole(P)	May 12	Dec 12	1024	532	48	11	0.003	
	Fusilade Max	TFMP(M)	Apr 12	Mar 15	1073	581	127	64	0.074	
	Glyfonova 450 Plus	Glyphosate(P)	Sep 12	Jun 15*	836	514	207	121	0.15	
		AMPA(M)	Sep 12	Jun 15*	836	514	207	121	0.067	
<b>Winter wheat 2013</b>	DFF	Diflufenican	Nov 12	Mar 15	463	270	68	69	0.006	
		AE-05422291(M)	Nov 12	Mar 15	463	270	68	69	<0.01	
		AE-B107137(M)	Nov 12	Mar 15	463	270	68	69	0.01	
<b>Spring barley 2013</b>	Duotril 400 EC	Ioxynil(P)	May 13	Mar 15	804	543	222	188	<0.01	
	Duotril 400 EC	Bromoxynil (P)	May 13	Mar 15	804	543	222	188	<0.01	
	Amistar	CyPM(M)	Jun 13	Oct16	1059	534	15	0	0.132	
	Glyfonova 450 Plus	Glyphosate(P)	Aug 13	Apr 16	1008	538	125	0	0.01	
		AMPA(M)	Aug 13	Apr 16	1008	538	125	0	0.01	
<b>Winter wheat 2014</b>	Oxitril CM	Ioxynil (P)	Oct 13	Mar 15	804	542	222	189	<0.01	
		Bromoxynil (P)	Oct 13	Mar 15	804	542	222	189	<0.01	
	DFF	Diflufenican (P)	Oct 13	Mar 15	804	542	222	189	0.01	
		AE-05422291 (M)	Oct 13	Mar 15	804	542	222	189	<0.01	
		AE-B107137 (M)	Oct 13	Mar 15	804	542	222	189	<0.01	
	Amistar	Azoxystrobin (P)	Jun 14	Jun 16	1288	630	46	0	0.013	
		CyPM (M)	Jun 14	Jun 16	1288	630	46	0	0.13	
	Glyfonova 450 Plus	Glyphosate (P)	Jul 14	Apr 16	1309	691	187	0	<0.01	
		AMPA (M)	Jul 14	Apr 16	1309	691	187	0	<0.01	
	<b>Maize 2015</b>	Callisto	Mesotrione (P)	May 15	May 18	1219	783	117	52	0.05
			AMBA (M)	May 15	May 18	1219	783	117	52	<0.01
			MNBA (M)	May 15	May 18	1219	783	117	52	<0.01
MaisTer		Foramsulfuron (P)	Jun 15	May 18	1257	791	100	37	<0.01	
		AE-F130619 (M)	Jun 15	May 18	1257	791	100	37	<0.01	
		AE-F092944 (M)	Jun 15	May 18	1257	791	100	37	<0.01	
<b>Maize 2016</b>		Callisto	Mesotrione (P)	Jun 16	May 18	562	826	77	26	0.1
			AMBA (M)	Jun 16	May 18	562	826	77	26	<0.01
			MNBA (M)	Jun 16	May 18	562	826	77	26	0.01
	MaisTer	Foramsulfuron (P)	Jun 16	May 18	514	881	82	121	0.03	
		AE-F130619 (M)	Jun 16	May 18	514	881	82	121	<0.01	
		AE-F092944 (M)	Jun 16	May 18	514	881	82	121	<0.01	
Iodosulfuron (P)	Triazinamine (M)	Jun 16	Mar 18	514	881	82	121	<0.01		
Harmony SX										
Thifensulfuron-methyl (P)	Triazinamine (M)	Jun 16	Mar 18	562	826	77	26	<0.01		

**Table A7.4B (continued).** Pesticides analysed at **Silstrup**. For each compound it is listed whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop – Year of harvest	Applied Product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of monitoring	Y 1 <sup>st</sup> Precip. (mm)	Y 1 <sup>st</sup> Percol. (mm)	M 1 <sup>st</sup> Precip. (mm)	M 1 <sup>st</sup> Percol. (mm)	C <sub>mean</sub> ( $\mu\text{g L}^{-1}$ )	
<b>Spring barley 2017</b>										
SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Bumper 25 EC									
	Propiconazole(P)	1,2,4-triazole (M)	Jun 17		520	980	112	0	*	
	Zypar									
	Florasulam(P)	TSA (M)	Jun 17	Mar 22	520	996	30	0	<0.01	
	Halauxifen-methyl(P)	X-757 (M)	Jun 17	Sept 19	520	996	30	0	<0.01	
<b>Winter barley 2018</b>										
SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Lexus 50 WG									
	Flupyrulfuron-methyl (P)	IN-KF311 (M)	Oct 17	Mar 19	983	623	120	96	<0.01	
		IN-JE127 <sup>a)</sup> (M)	Oct 17	Mar 19	983	623	120	96	<0.01	
	Hussar Plus OD									
	Mesosulfuron-methyl (P)	AE F099095 (M)	Apr 18	Mar 19	1009	541	67	11	<0.01	
		AE F160459 (M)	Apr 18	Mar 19	1009	541	67	11	<0.01	
		AE F147447 (M)	Apr 18	Mar 19	1009	541	67	11	<0.01	
	Proline EC 250									
	Prothioconazole (P)	1,2,4-triazole (M)	May 18	Jun 20	990	530	29	1	*	
<b>Winter rapeseed 2019</b>										
SD: Thiram	Focus Ultra	BH 517-T2SO2 (M)	Sept 18	Oct 20	1124	560	60	34	<0.01	
	Cycloxydim (P)	E/Z BH 517-TSO (M)	Sept 18	Oct 20	1124	560	60	34	0.05	
	Kerb 400 SC									
	Propyzamide (P)	Propyzamide (P)	Nov 18	Sep 21	1276	674	124	93	0.03	
			CGA 287422 (M)	Apr 19	Dec 21	1390	782	25	4	<0.01
	Agil 100EC		CGA 294972 (M)	Apr 19	Dec 21	1390	782	25	4	<0.01
	Propaquizifop (P)		CGA 290291 (M)	Apr 19	Dec 21	1390	782	25	4	<0.01
			PPA (M)	Apr 19	Dec 21	1390	782	25	4	<0.01
<b>Winter wheat 2020</b>										
SD: Celest Formula M (Fludioxonil)	Broadway	Pyroxsulam (P)	PSA (M)	Apr 20	Mar 22	-	-	30	4	-
			6-Cl-7-OH-pyroxsulam (M)	Apr 20	Mar 22	-	-	30	4	-
			5-OH-pyroxsulam (M)	Apr 20	Mar 22	-	-	30	4	-
			7-OH-pyroxsulam (M)	Apr 20	Mar 22	-	-	30	4	-
			Pyridine sulfonamide (M)	Apr 20	Mar 22	-	-	30	4	-
	Florasulam (P)		TSA(M)	Apr 20	Mar 22	-	-	30	4	-
			5OH-florasulam (M)	Apr 20	Mar 22	-	-	30	4	-
			DFP-ASTCA (M)	Apr 20	Mar 22	-	-	30	4	-
			DFP-TSA (M)	Apr 20	Mar 22	-	-	30	4	-
	Proline 250 EC	Prothioconazole (P)	1,2,4-triazole (M)		May 20	-	-	28	0	-
	Amistar	Azoxystrobin (P)	Azoxystrobin (P)		May 20	-	-	28	0	-
					May 20					
	<b>Winter wheat 2021</b>									
	SD: Difend (Difenoconazole)	Propulse SE 250								
Prothioconazole		1,2,4-triazole (M)	Jun 21							
	Fluopyram	Fluopyram	Jun 21							
<b>Spring barley 2021</b>										
<b>Winter wheat 2022</b>										
SD: Seedron (Fludioxonil + tebuconazole)	Express Gold 33 SX	IN-B5528 (M)	Apr 22							
	Tribenuron-methyl	IN-R9805 (M)	Apr 22							
	Metsulfuron-methyl	M2 (M)	Apr 22							
	Propulse SE 250	1,2,4-triazole (M)								
	Prothioconazole	Fluopyram		May 22						
	Fluopyram	Fluopyram-7-hydroxy (M)	May 22							

Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1. SD = Seed dressing. <sup>a)</sup> The degradation product IN-J127 was discontinued due to instability in aqueous solution (Chapter 8). \* Due to a high background content of 1,2,4-triazole, the results of the analysis cannot be linked directly to the specific application, why C<sub>mean</sub> is not presented.

**Table A7.5A.** Pesticides analysed at **Estrup** with the product used shown in parentheses. Degradation products are in italics. Precipitation (prec.) and percolation (perc.) are accumulated from the date of first application until the end of monitoring. 1<sup>st</sup> month perc. refers to accumulated percolation within the first month after application. C<sub>mean</sub> refers to average leachate concentration in the drainage water within the first drainage season after application. (See Appendix 2 for calculation methods).

Crop and analysed pesticides	Application date	End of monitoring	Prec. (mm)	Perc. (mm)	1 <sup>st</sup> month perc. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Spring barley 2000</b>						
Metsulfuron-methyl (Ally)	May 00	Apr 03	2990	1456	29	<0.01
- <i>triazinamin</i>						<0.02
Flamprop-M-isopropyl (Barnon Plus 3)	May 00	Apr 03	2914	1434	2	0.02
- <i>flamprop (free acid)</i>						0.01
Propiconazole (Tilt Top)	Jun 00	Apr 05	4938	2294	0	0.01
Fenpropimorph (Tilt Top)	Jun 00	Jul 02	2211	1048	0	<0.01
- <i>fenpropimorphic acid</i>						<0.02
Dimethoate (Perfekthion 500 S)	Jun 00	Jul 02	2211	1048	0	<0.01
<b>Pea 2001</b>						
Glyphosate (Roundup Bio)	Oct 00	Jul 14 <sup>†</sup>	10484	4977	123	0.54
- <i>AMPA</i>						0.17
Bentazone (Basagran 480)	May 01	Jul 08	7629	3621	9	0.03
- <i>AIBA</i>						<0.01
Pendimethalin (Stomp SC)	May 01	Jul 03	2208	1096	9	<0.01
Pirimicarb (Pirimor G)	Jun 01	Jul 05	4251	1995	10	0.01
- <i>pirimicarb-desmethyl</i>						<0.02
- <i>pirimicarb-desmethyl-formamido</i>						<0.02
<b>Winter wheat 2002</b>						
loxylin (Oxitril CM)	Nov 01	Jul 03	1580	860	52	0.04 <sup>†j</sup>
Bromoxynil (Oxitril CM)	Nov 01	Jul 03	1580	860	52	0.01 <sup>†j</sup>
Amidosulfuron (Gratil 75 WG)	Apr 02	Jul 04	2148	928	8	<0.01
MCPA (Metaxon)	May 02	Jul 04	2091	928	0	<0.01
- <i>4-chlor,2-methylphenol</i>						<0.01
Propiconazole (Tilt 250 EC)	May 02	Apr 05	2920	1336	39	0.02
Pirimicarb (Pirimor G)	Jun 02	Jul 05	2982	1403	58	0.01
- <i>pirimicarb-desmethyl</i>						<0.02
- <i>pirimicarb-desmethyl-formamido</i>		Apr 06				<0.02
<b>Fodder beet 2003</b>						
Glyphosate (Roundup Bio)	Sep 02	Jul 14	8289	3900	0	0.43
- <i>AMPA</i>						0.19
Ethofumesate (Betanal Optima)	May 03	Apr 06	2901	1371	50	0.11
Metamitron (Goltix WG)	May 03	Apr 06	2901	1371	50	1.1
- <i>metamitron-desamino</i>						0.21
Pirimicarb (Pirimor G)	Jul 03	Jul 05	2071	939	0	<0.01
- <i>pirimicarb-desmethyl</i>		Jul 05				<0.01
- <i>pirimicarb-desmethyl-formamido</i>		Apr 06				0.12
<b>Spring barley 2004</b>						
Fluroxypyr (Starane 180)	May 04	Jul 06	2073	1030	0	<0.02
Azoxystrobin (Amistar)	Jun 04	Jul 08	4452	2209	38	0.12
- <i>CyPM</i>						0.23
<b>Maize 2005</b>						
Terbuthylazine (Inter-Terbuthylazin)	May 05	Apr 09	4247	2042	32	0.48
- <i>desethyl-terbuthylazine</i>		Jul 09	4406	2051	32	0.31
- <i>2-hydroxy-terbuthylazine</i>		Jul 08	3338	1628	32	0.11
- <i>desisopropyl-atrazine</i>		Apr 09	4247	2042	32	0.02
- <i>2-hydroxy-desethyl-terbuthylazine</i>		Jul 08	3338	1628	32	0.24
Bentazone (Laddok TE)	Jun 05	Jul 08	3338	1628	10	0.18
- <i>AIBA</i>						<0.01
Glyphosate (Roundup Bio)	Nov 05	Jul 14	5191	2460	68	4.04 <sup>†j</sup>
- <i>AMPA</i>						0.42 <sup>†j</sup>
<b>Spring barley 2006</b>						
Florasulam (Primus)	Jun 06	Jul 08	2442	1163	0	<0.01
- <i>florasulam-desmethyl</i>						<0.03
Azoxystrobin (Amistar)	Jun 06	Jul 08	2414	1170	0	0.03
- <i>CyPM</i>						0.13

**Table A7.5A continued.** Pesticides analysed at **Estrup** with the product used shown in parentheses. Degradation products are in italics. Precipitation (prec.) and percolation (perc.) are accumulated from the date of first application until the end of monitoring. 1<sup>st</sup> month perc. refers to accumulated percolation within the first month after application. C<sub>mean</sub> refers to average leachate concentration in the drainage water within the first drainage season after application. (See Appendix 2 for calculation methods).

Crop and analysed pesticides	Application date	End of monitoring	Prec. (mm)	Perc. (mm)	1 <sup>st</sup> month perc. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Winter wheat 2007</b>						
Mesosulfuron-methyl (Atlantis WG)	Oct 06	Jul 08	1420	305	29	0.01
- <i>Mesosulfuron</i>	Oct 06	Jul 08	1420	305	29	<0.02
Chloromequat (Cycocel 750)	Apr 07	Jul 08	1261	287	0	<0.01
Epoxiconazole (Opus)	May 07	Jul 08	1154	299	29	0.02

*Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1.*

*The values for prec. and perc. are accumulated up to July 2006.*

<sup>1)</sup> *Drainage runoff commenced about two and a half months prior to the application of ioxynil and bromoxynil, and the weighted concentrations refer to the period from the date of application until 1 July 2002.*

**Table A7.5B.** Pesticides analysed at **Estруп**. For each compound it is listed, whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop	Applied product	Analysed pesticide /degradation product	Appl. date	End mon.	Y 1 <sup>st</sup> precip	Y 1 <sup>st</sup> percol	M 1 <sup>st</sup> precip	M 1 <sup>st</sup> percol	C <sub>mean</sub>
<b>Winter wheat 2008</b>	Amistar	Azoxystrobin(P)	Jun 08	Jun 12	1093	232	88	0	0.06
		CyPM(M)	Jun 08	Jun 12	1093	232	88	0	0.48
	Folicur EC 250	Tebuconazole(P)	Nov 07	Mar 10	1325	275	103	31	0.44
	Pico 750 WG	Picolinafen(P)	Oct 07	Mar 10	1253	267	76	24	0.03
	Roundup Max	CL 153815(M)	Oct 07	Mar 10	1253	267	76	24	0.24
		Glyphosate(P) AMPA(M)	Sep 07 Sep 07	Jun 12 Jun 12	1200 1200	261 261	113 113	29 29	0.19 0.13
<b>Spring barley 2009</b>	Amistar	Azoxystrobin(P)	Jun 09	Jun 12	1215	235	60	0	0.04
		CyPM(M)	Jun 09	Jun 12	1215	235	60	0	0.41
	Basagran M75	Bentazone(P)	May 09	Jun 12	1222	238	83	4	0.05
	Fox 480 SC	Bifenox(P)	May 09	Jun 12	1243	246	87	16	<0.02
		Bifenox acid(M) Nitrofen(M)	May 09 May 09	Jun 12 Jun 12	1243 1243	246 246	87 87	16 16	0.16 <0.01
<b>Winter rape 2010</b>	Biscaya OD 240	Thiacloprid(P)	May 10	Mar 12	1083	196	43	0	<0.01
		M34(M)	May 10	Mar 12	1083	196	43	0	<0.02
		Thiacloprid sulfonic acid(M)	May 10	Mar 12	1083	196	43	0	<0.1
		Thiacloprid-amide(M)	May 10	Mar 12	1083	196	43	0	<0.01
<b>Winter wheat 2011</b>	Express ST	Triazinamin-methyl(M)	Sep 10	Aug 12	823	176	97	31	0.01
	Fox 480 SC	Bifenox(P)	Apr 11	Dec 12	1217	276	45	2	<0.01
		Bifenox acid(M)	Apr 11	Dec 12	1217	276	45	2	0.003
		Nitrofen (M)	Apr 11	Dec 12	1217	276	45	2	<0.01
	Flexity	Metrafenone(P)	May 11	Apr 15	1219	283	114	6	0.02
	Roundup Max	Glyphosate(P)	Oct 11	Jun 15	1150	295	94	26	0.88
AMPA(M)		Oct 11	Jun 15	1150	295	94	26	0.26	
<b>Spring barley 2012</b>	Amistar	Azoxystrobin(P)	Jun 12	Apr 16	1083	281	151	29	0.04
		CyPM(M)	Jun 12	Apr 16	1083	281	151	29	0.24
	Fox 480 SC	Bifenox(P)	May 12	Dec 12	1090	281	39	13	< 0.02
		Bifenox acid(M)	May 12	Dec 12	1090	281	39	13	0.011
		Nitrofen(M)	May 12	Dec 12	1090	281	39	13	< 0.02
Mustang forte	Aminopyralid(P)	May 12	Jun 13	1098	285	50	14	< 0.01	
<b>Pea 2013</b>	Fighter 480	Bentazone(P)**	May 13	Apr 16	1071	248	35	10	0.059
	Command CS	Clomazone(P)	Apr 13	Apr 15	1094	243	61	17	<0.01
		FMC-65317(M)	Apr 13	Apr 15	1094	243	61	17	<0.02
	Glyfonova 450 Plus	Glyphosate(P)	Aug 13	Apr 16	928	237	131	13	0.10
		AMPA(M)	Aug 13	Apr 16	928	237	131	13	0.07

**Table A7.5B (continued)** Pesticides analysed at **Estrup**. For each compound it is listed, whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop – Year of harvest	Applied product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of monitoring	Y 1 <sup>st</sup> Precip. (mm)	Y 1 <sup>st</sup> Percol. (mm)	M 1 <sup>st</sup> Precip. (mm)	M 1 <sup>st</sup> Percol. (mm)	C <sub>mean</sub> ( $\mu\text{g L}^{-1}$ )
<b>Winter wheat 2014</b>	DFF	Diflufenican(P)	Nov 13	Apr 15	582	165	86	30	0.19
		AE-05422291(M)	Nov 13	Apr 15	582	165	86	30	<0.01
		AE-B107137(M)	Nov 13	Apr 15	582	165	86	30	0.03
	Folicur EC 250 Tebuconazole (P)	1,2,4-triazole(M)	May 14	Jun 20*	1152	249	51	0.4	x
	Amistar	Azoxystrobin(P)	Jun 14	Apr 16	1176	257	49	0	0.02
		CyPM(M)	Jun 14	Apr 17	1176	257	49	0	0.38
	Glyfonova 450 Plus	Glyphosate(P)	Jul 14	May 16	1219	305	117	0	0.06
AMPA(M)		Jul 14	May 16	1219	305	117	0	0.1	
<b>Maize 2015</b>	Callisto Mesotrione (P)	Mesotrione(P)	May 15	May 18	1196	299	91	23	0.11
		AMBA(M)	May 15	May 18	1196	299	91	23	<0.01
		MNBA(M)	May 15	May 18	1196	299	91	23	<0.01
	MaisTer Foramsulfuron-methyl (P)	Foramsulfuron(P)	May 15	May 18	1196	299	91	23	<0.01
		AE-F130619(M)	May 15	May 18	1196	299	91	23	<0.01
	Iodosulfuron-methyl (P)	AE-F092944(M)	May 15	May 18	1196	299	91	23	<0.01
<b>Maize 2016</b>	Callisto	Mesotrione(P)	Jun 16	May 18	870	209	148	19	<0.01
		AMBA(M)	Jun 16	May 18	870	209	148	19	<0.01
		MNBA(M)	Jun 16	May 18	870	209	148	19	<0.01
	Harmony SX Thifensulfuron-methyl (P)	Triazinamine(M)	Jun 16	May 18	870	209	148	19	<0.01
	MaisTer Foramsulfuron-methyl (P)	Foramsulfuron(P)	Jun 16	May 18	936	204	201	28	<0.01
		AE-F130619(M)	Jun 16	May 18	936	204	201	28	<0.01
	Iodosulfuron-methyl (P)	AE-F092944(M)	Jun 16	May 18	936	204	201	28	<0.01
	<b>Pea 2017</b>	<b>Winter wheat 2018</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Hussar Plus OD AE-F099095 (M)	Apr 18	Mar 20	876	231	45	13
Mesosulfuron-methyl (P) AE-F160459 (M)			Apr 18	Mar 20	876	231	45	13	<0.01
Mesosulfuron-methyl (P) AE-F147447 (M)			Apr 18	Mar 19	876	231	45	13	<0.01
Topsin WG Thiophanat-methyl (P)			Carbendazim (M)	Jun 18	Oct 20	898	187	32	2
<b>Spring barley 2019</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Pixxaro EC Halauxifen-methyl (P)	X-729 (M)	May 19	Mar 21	1365	257	81	0	<0.01
		Fluroxypyr (P)							
	Juventus 90 Metconazole (P)	Metconazole (P)	May 19	Mar 21	1365	257	81	0	<0.01
		1,2,4-triazole (M)	May 19		1365	257	81	0	x
<b>Winter wheat 2020</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Broadway Pyroxsulam (P)	Amitrol (M)	May 20	Mar 22	-	-	-6	25	-
		PSA (M)	May 20	Mar 22	-	-	-6	25	-
		6-Cl-7-OH-pyroxsulam (M)	May 20	Mar 22	-	-	-6	25	-
		5-OH-pyroxsulam (M)	May 20	Mar 22	-	-	-6	25	-
		7-OH-pyroxsulam (M)	May 20	Mar 22	-	-	-6	25	-
	Florasulam (P)	Pyridine sulfonamide (M)	May 20	Mar 22	-	-	-6	25	-
		TSA (M)	May 20	Mar 22	-	-	-6	25	-
		5OH-florasulam (M)	May 20	Mar 22	-	-	-6	25	-

Crop – Year of harvest	Applied product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of monitoring	Y 1 <sup>st</sup> Precip. (mm)	Y 1 <sup>st</sup> Percol. (mm)	M 1 <sup>st</sup> Precip. (mm)	M 1 <sup>st</sup> Percol. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
		DFP-ASTCA (M)	May 20	Mar 22	-	-	-6	25	-
		DFP-TSA (M)	May 20	Mar 22	-	-	-6	25	-
<b>Spring barley 2021</b>	Harmony 50 SX	IN-B5528 (M)		Jun 21					
SD: Redrigo Pro 170 FS (Prothioconazole + tebuconazole)	Thifensulfuron-methyl	IN-JZ789 (M)		Jun 21					
		IN-L9223 (M)		Jun 21					
<b>Perennial ryegrass 2022</b>	Harmony 50 SX	IN-B5528 (M)		Jul 22					
	Thifensulfuron-methyl	IN-JZ789 (M)		Jul 22					
		IN-L9223 (M)		Jul 22					

Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1. SD = Seed dressing. \* Due to a high background content of 1,2,4-triazole, the results of the analysis cannot be linked directly to the specific application, why  $c_{mean}$  is not presented.

**Table A7.6A.** Pesticides analysed at **Faardrup** with the product used shown in parentheses. Degradation products are in italics. Precipitation (prec.) and percolation (perc.) are accumulated from the date of first application (approx. date) until the end of monitoring. 1<sup>st</sup> month perc. refers to accumulated percolation within the first month after application. C<sub>mean</sub> refers to average leachate concentration in the drainage water the first drainage season after application. (See Appendix 2 for calculation methods).

Crop and analysed pesticides	Application date	End of monitoring	Prec. (mm)	Perc. (mm)	1 <sup>st</sup> month perc. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Winter wheat 2000</b>						
Glyphosate (Roundup 2000)	Aug 99	Apr 03	2526	947	0	<0.01
- <i>AMPA</i>						<0.01
Bromoxynil (Briotril)	Oct 99	Apr 02	1738	751	35	<0.01
loxynil (Briotril)	Oct 99	Apr 02	1738	751	35	<0.01
Fluroxypyr (Starane 180)	Apr 00	Apr 02	1408	494	7	<0.01
Propiconazole (Tilt Top)	May 00	Jul 03	2151	669	0	<0.01
Fenpropimorph (Tilt Top)	May 00	Jul 02	1518	491	0	<0.01
- <i>fenpropimorphic acid</i>						<0.01
Pirimicarb (Pirimor G)	Jun 00	Jul 03	2066	684	0	<0.01
- <i>pirimicarb-desmethyl</i>						<0.01
- <i>pirimicarb-desmethyl-formamido</i>						<0.02
<b>Sugar beet 2001</b>						
Glyphosate (Roundup 2000)	Oct 00	Jul 03	1747	709	0	<0.01
- <i>AMPA</i>						0.01
Metamitron (Goltix WG)	May 01	Jul 03	1512	507	4	0.01
- <i>metamitron-desamino</i>						0.01
Ethofumesate (Betanal Optima)	May 01	Jul 03	1512	507	4	0.06
Desmedipham (Betanal Optima)	May 01	Jul 03	1512	507	4	<0.01
- <i>EHPC</i>						<0.02
Phenmedipham (Betanal Optima)	May 01	Jul 03	1512	507	4	<0.01
- <i>MHPC</i>						<0.02
Fluazifop-P-butyl (Fusilade X-tra)	Jun 01	Jul 03	1460	503	0	<0.01
- <i>fluazifop-P (free acid)</i>						0.02
Pirimicarb (Pirimor G)	Jul 01	Jul 03	1460	503	1	<0.01
- <i>pirimicarb-desmethyl</i>						<0.01
- <i>pirimicarb-desmethyl-formamido</i>						<0.02
<b>Spring barley 2002</b>						
Flamprop-M-isopropyl (Barnon Plus 3)	May 02	Jul 04	1337	333	0	<0.01
- <i>flamprop-M (free acid)</i>						<0.01
MCPA (Metaxon)	May 02	Jul 04	1358	337	4	<0.01
- <i>4-chlor-2-methylphenol</i>						<0.02
- <i>triazinamin-methyl<sup>1)</sup> (Express)</i>	May 02	Jul 04	1358	337	4	<0.02
Dimethoate (Perfekthion 500 S)	Jun 02	Jul 04	1328	333	0	<0.01
Propiconazole (Tilt 250 EC)	Jun 02	Jul 04	1328	333	0	<0.01
<b>Winter rape 2003</b>						
Clomazone (Command CS)	Aug 02	Apr 05	1761	509	4	<0.02
- <i>FMC 65317 (propanamide-clomazon)</i>						<0.02
<b>Winter wheat 2004</b>						
Prosulfocarb (Boxer EC)	Oct 03	Apr 06	1542	454	0	<0.01
MCPA (Metaxon)	Jun 04	Jul 06	1307	331	0	<0.01
- <i>4-chlor,2-methylphenol</i>						<0.01
Azoxystrobin (Amistar)	Jun 04	Jul 07	2098	636	0	<0.01
- <i>CyPM</i>						<0.01
<b>Maize 2005</b>						
Terbutylazine (Inter-Terbutylazin)	May 05	Jul 08	2078	666	4	0.67
- <i>desethyl-terbutylazine</i>	May 05	Jul 08	2078	666		0.59
- <i>2-hydroxy-terbutylazine</i>	May 05	Jul 08	2078	666		0.04
- <i>desisopropyl-atrazine</i>	May 05	Jul 08	2078	666		0.03
- <i>2-hydroxy-desethyl-terbutylazine</i>	May 05	Jul 07	1428	465	4	0.07
Bentazone (Laddok TE)	May 05	Jul 07	1408	464	6	2.82
- <i>AIBA</i>						<0.01
<b>Spring barley 2006</b>						
Fluroxypyr (Starane 180 S)	May 06	Jul 08	1496	524	17	<0.02
Epoxiconazole (Opus)	Jun 06	Jul 08	1441	507	3	<0.01

Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1.

<sup>1)</sup> Degradation product of tribenuron-methyl. The parent compound degrades too rapidly to be detected by monitoring.

† Monitoring will continue during the following year. The values for prec. and perc. are accumulated up to July 2009.

**Table A7.6B.** Pesticides analysed at **Faarstrup**. For each compound it is listed whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop	Applied product	Analysed pesticide /degradation product	Appl. date	End mon.	Y 1 <sup>st</sup> Precip.	Y 1 <sup>st</sup> Percol.	M 1 <sup>st</sup> Precip.	M 1 <sup>st</sup> Percol.	C <sub>mean</sub>
<b>Spring barley 2006</b>	Opus	Epoxiconazole(P)	Jun 06	Jun 08	790	306	17	3	<0.01
	Starane 180 S	Fluroxypyr(P)	May 06	Jun 08	708	333	37	17	<0.02
<b>Winter rape 2007</b>	CruiserRAPS	Thiamethoxam(P)	Aug 06	Jun 08	806	294	57	23	<0.01
		CGA 322704(M)		Jun 08	806	294	57	23	<0.02
	Kerb 500 SC	Propyzamide(P)	Feb 07	Mar 09	735	199	64	46	0.01
		RH-24580(M)		Mar 09	735	199	64	46	<0.01
		RH-24644(M)		Mar 09	735	199	64	46	<0.01
	RH-24655(M)		Mar 09	735	199	64	46	<0.01	
<b>Winter wheat 2008</b>	Folicur 250	Tebuconazole(P)	Nov 07	Dec 09	693	158	64	56	<0.01
	Stomp SC	Pendimethalin(P)	Oct 07	Dec 09	673	180	51	24	<0.01
<b>Sugar beet 2009</b>	Ethosan	Ethofumesate(P)	Apr 09	Jun 11	609	146	50	2	0.01
	Goliath	Metamitron(P)	Apr 09	Jun 11	609	146	42	2	0.02
		Desamino-metamitron(M)	Apr 09	Jun 11	609	146	42	2	0.06
	Safari	Triflusaluron-methyl(P)	Apr 09	Jun 11	609	146	50	2	<0.01
		IN-D8526(M)	Apr 09	Jun 11	609	146	50	2	<0.01
		IN-E7710(M)	Apr 09	Jun 11	609	146	50	2	<0.01
IN-M7222(M)		Apr 09	Jun 11	609	146	50	2	<0.02	
<b>Spring barley and</b>	Fighter 480	Bentazone(P)	Jun 10	Jun 15*	693	327	49	29	<0.01
	Bentazone(P)								
<b>Red fescue 2010</b>	Fox 480 SC	Bifenox(P)	Oct 10	Jun 12	351	190	75	72	0.02
	Bifenox(P)	Bifenox acid(M)	Oct 10	Jun 12	351	190	75	72	2.54
		Nitrofen(M)	Oct 10	Jun 12	351	190	75	72	0.01
<b>Red fescue 2011</b>	Fusilade Max	Fluazifop-P(M)	May 11	Mar 12	730	0	59	0	<0.01
	Fluazifop-P-butyl (P)	TFMP(M)	May 11	Apr 15	730	0	59	0	<0.01
<b>Spring barley and</b>	Glyphogan	Glyphosate(P)	Oct 11	Aug 12	425	17	56	17	<0.01
<b>White clover 2012</b>	Glyphosate(P)	AMPA(M)	Oct 11	Aug 12	425	17	56	17	<0.01
	Fighter 480	Bentazone(P)	May 12	Sept 15	527	220	29	4	<0.01
		Bentazone(P)							
	Flexity	Metrafenone(P)	Jun 12	Apr 15	580	215	96	14	<0.01
	Metrafenone(P)								
<b>White clover 2013</b>	Fighter 480	Bentazone(P)	May 13	Sept 15	711	213	82	0	0.02
		Bentazone(P)							
	Kerb 400 SC	Propyzamid(P)	Jan 13	Apr 15	640	213	64	51	<0.01
		RH-24560(M)	Jan 13	Apr 15	640	213	64	51	<0.01
		RH-24644(M)	Jan 13	Apr 15	640	213	64	51	<0.01
	RH-24655(M)	Jan 13	Apr 15	640	213	64	51	<0.01	
<b>Winter wheat 2014</b>									

**Table A7.6B (continued).** Pesticides analysed at **Faardrup**. For each compound it is listed whether it is a pesticide (P) or degradation product (M), as well as the application date (Appl. date) and end of monitoring period (End. mon.). Precipitation (precip. in mm) and percolation (percol. in mm) are accumulated within the first year (Y 1<sup>st</sup> Precip, Y 1<sup>st</sup> Percol) and first month (M 1<sup>st</sup> Precip, M 1<sup>st</sup> Percol) after the first application. C<sub>mean</sub> refers to average leachate concentration [ $\mu\text{g L}^{-1}$ ] at 1 mbgs the first year after application. See Appendix 2 for calculation method. For the current reporting period, no values for C<sub>mean</sub> are presented as the calculation method for C<sub>mean</sub> is under revision.

Crop– Year of harvest	Applied Product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of Monitoring	Y 1 <sup>st</sup> Precip. (mm)	Y 1 <sup>st</sup> Percol. (mm)	M 1 <sup>st</sup> Precip. (mm)	M 1 <sup>st</sup> Percol. (mm)	C <sub>mean</sub> ( $\mu\text{g L}^{-1}$ )	
<b>Winter wheat 2015</b>	Folicur EC250 Tebuconazole (P)	1,2,4-triazole (M)**	Nov 14	Sept 15	796	241	73	51	0.03	
	Lexus 50 WG Flupyr-sulfuron-methyl(P)	Flupyr-sulfuron-methyl(P)	Nov 14+ Apr 15	Oct 16	796	241	94	81	<0.01	
		IN-JV460(M)	Nov 14+ Apr 15	Oct 16	796	241	94	81	<0.01	
		IN-KY374(M)	Nov 14+ Apr 15	Oct 16	796	241	94	81	<0.01	
		IN-KC576(M)	Nov 14+ Apr 15	Oct 16	796	241	94	81	<0.01	
<b>Spring Barley 2016</b>	Starane 180S Fluroxypyr-meptyl (P)	Fluroxypyr methoxy-pyridine(M)	May 15	May 18	785	286	46	0	<0.01	
		Fluroxypyr pyrdinol(M)	May 15	May 18	785	286	46	0	<0.01	
	Bumper 25 EC Propiconazole(P) <sup>1)</sup>	1,2,4-triazole(M)	Jun 16		621	204	129	23	*	
<b>Spring Barley 2017</b>	Zypar Florasulam(P)	TSA (M)	Jun 17	Mar 19	1176	271	110	0	<0.01	
	SD: Fungazil A (Imazalil) Halauxifen-methyl (P)	X-757 (M)	Jun 17	Mar 19	1176	271	110	0	<0.01	
	Bumper 25 EC Propiconazole(P) <sup>2)</sup>	1,2,4-triazole (M)	Jun 17		1176	271	110	0	*	
<b>Sugar Beet 2018</b>	Conviso One Thiencarbazone-methyl (P)	AE1394083 (M)	May 18	Mar 20	607	234	31	0	<0.01	
		Foramsulfuron (P)								
	SD: Gaucho WS70 (Imidacloprid) + Tachigaren WP (Hymexazol)	Goltix SC 700 Metamitron (P)	Metamitron (P)	May 18	Mar 20	607	234	31	0	<0.01
		Desamino-metamitron (M)	MTM-126-ATM (M)	May 18	Mar 20	607	234	31	0	<0.01
<b>Spring barley 2019</b>	SD: Redigo Pro 170 FS (prothioconazole and tebuconazole)	IN-MM671 (M)	Jun 19	Mar 21	758	407	69	10	<0.01	
		IN-MM991 (M)	Jun 19	Mar 21	758	407	69	10	<0.01	
<b>Spring wheat 2020</b>	SD: Celest Formula M (Fludioxonil)		Apr 20		-	-	32	3	-	
			Apr 20		-	-	32	3	-	
<b>Winter rapeseed 2021</b>	Kerp 400 SC	Propyzamide	Nov 20							
	SD: Integral Pro ( <i>Bacillus amyloliquefaciens</i> MBI 600)	Propyzamide								
		Propulse SE 250 Prothioconazole	1,2,4-triazole (M)	May 21						
	Fluopyram	Fluopyram	May 21							

Crop– Year of harvest	Applied Product	Analysed Pesticide (P) / Degradation product (M)	Application date	End of Monitoring	Y 1 <sup>st</sup> Precip. (mm)	Y 1 <sup>st</sup> Percol. (mm)	M 1 <sup>st</sup> Precip. (mm)	M 1 <sup>st</sup> Percol. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Winter wheat 2022</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Express Gold 33 SX	IN-B5528 (M)	Apr 22						
	Tribenuron-methyl	IN-R9805 (M)	Apr 22						
	Metsulfuron-methyl	M2 (M)	Apr 22						
	Propulse SE 250	1,2,4-triazole (M)	May 22						
	Prothioconazole Fluopyram	Fluopyram FLUopyram-7-hydroxy	May 22 May 22						

*Systematic chemical nomenclature for the analysed pesticides is given in Appendix 1. SD = Seed dressing. <sup>1)</sup> Propiconazole only applied in half of the maximum allowed dose. <sup>2)</sup> Propiconazole applied twice 19 June and 7 July. <sup>3)</sup> Proquinazid applied twice on 3 and 17 June. \*\*Monitoring started in May 2014. <sup>x</sup> Due to a high background content of 1,2,4-triazole, the results of the analysis cannot be linked directly to the specific application, why  $c_{mean}$  is not presented.*

**Table A7.7A.** Pesticides analysed at Lund. Precipitation (precip.) and percolation (percol.) are accumulated within the first year (Y 1<sup>st</sup>), and month (M 1<sup>st</sup>) after application. C<sub>mean</sub> is average leachate concentration at 1 mbgs. See Appendix 2 for the calculation method.

Crop – Year of harvest	Applied Product	Analysed Pesticide (P) / Degradation product (M)	Application. date	End of monitoring	Y 1 <sup>st</sup> Precip. (mm)	Y 1 <sup>st</sup> Percol. (mm)	M 1 <sup>st</sup> Precip. (mm)	M 1 <sup>st</sup> Percol. (mm)	C <sub>mean</sub> (µg L <sup>-1</sup> )
<b>Spring barley 2017</b> SD: Fungazil A (Imazalil)	Fighter 480	Bentazon (P)	May 17	Mar 19	nd	nd	nd	Nd	nd
	Amistar	Azoxystrobin (P) CyPM (M)	Jun 17	Mar 19	nd	nd	nd	nd	nd
			Jun 17	Mar 19	nd	nd	nd	nd	nd
Glyphonova 450 Plus	Glyphosate(P) AMPA(M)	Oct 17	Sept 19	nd	nd	nd	nd	nd	nd
		Oct 17	Sept 19	nd	nd	nd	nd	nd	nd
<b>Spring barley 2018</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Zypar Florasulam (P)	TSA (M)	May 18	Mar 21	537	92	39	-25	<0.01
	Proline 250 EC Prothioconazole (P)	1,2,4-triazole (M)	May 18		564	95	36	-25	n
<b>Winter barley 2019</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Zypar Florasulam (P)	TSA (M)	May 19	Mar 21	525	89	22	-24	<0.01
	Halauxifen-methyl (P)	X-729 (M)	May 19	Mar 21	525	89	22	-24	<0.01
<b>Winter rapeseed 2020</b> SD: <i>Bacillus amyloliquefaciens</i> MBI 600	Kerb 400 SC Propyzamid (P)	Propyzamid (P) RH-24644 (M) RH-24580 (M)	Dec 19	Sep 21	-	-			-
			Dec 19	Sep 21	-	-	53	49	-
			Dec 19	Sep 21	-	-	53	49	-
	Belkar Picloram (P) Halauxifen-methyl (P)	Picloram (P) X-729 (M)	Dec 19	Dec 21	-	-	53	49	-
			Dec 19	Dec 21	-	-	53	49	-
<b>Winter wheat 2021</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Propulse SE 250 Prothioconazole Fluopyram	1,2,4-triazole (M) Fluopyram	Jun 21 Jun 21						
<b>Spring barley 2022</b> SD: Redigo Pro 170 FS (Prothioconazole + tebuconazole)	Tribenuron-methyl	IN-B5528 (M)	May 22						
		IN-R9805 (M)	May 22						
		M2 (M)	May 22						
	Propulse SE 250 Prothioconazole Fluopyram	1,2,4-triazole (M) Fluopyram	May 22 May 22						

<sup>x</sup> Due to a high background content of 1,2,4-triazole, the results of the analysis cannot be linked directly to the specific application, why C<sub>mean</sub> is not presented.

## Appendix 8

### Horizontal wells

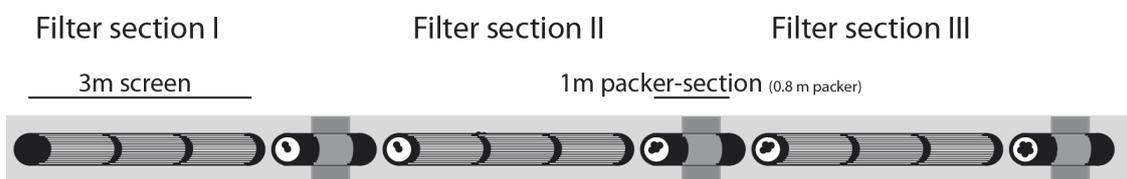
At all PLAP fields (except Lund), additional horizontal wells with three horizontal screens were established in September 2011.

A horizontal well with three PE screens (3 m long, separated by 1 m packer-section attached 0.8 m bentonite, slits of 0.1 mm, Figure A8.1) was installed to optimize monitoring of the fields both in time and space.

At the sandy fields (Tylstrup and Jyndevad), the wells were installed to improve sampling of the upper fluctuating groundwater. The location and horizontal extent of the well screens enable collection of spatially representative samples of the pore water, just reaching the groundwater zone. The wells (labelled "H1") were installed at 4.5 m depth at Tylstrup and 2.5 m depth at Jyndevad.

At the clay till fields (Silstrup "H3", Estrup "H2", and Faardrup "H3"), the wells were installed to improve spatial representability of the water sampled in the variably saturated zone below drain-depth. To ensure this, the wells were installed at 2 m depth and oriented such that they are orthogonal to the orientation of the dominating fracture system and crossing underneath a drain line with one of the three filter sections/screens. Also, the wells were installed so they are not affected by or affecting sampling from the vertical monitoring wells.

The location of the wells on the PLAP fields is illustrated in Figures 2.1.1, 2.2.1, 2.3.1, and 2.4.1. The wells/screens/filter sections are installed in boreholes of 9 cm in diameter. These boreholes are drilled by applying the directional drilling system Rotamole™, which uses a dry percussion-hammer air pressure technique causing minimal disturbances of the soil medium.



**Figure A8.1.** Design of a horizontal well with three filter sections of 3 m (inner diameter 25 mm; outer diameter 32 mm) each separated by 1m packer-section attached 0.8 m bentonite (thickness at installation 1 cm; expand to a thickness of 3.5 cm). Water can be sampled through two PE tubes (inner diameter 4 mm; outer diameter 6 mm) ending 1 and 2 meters into each section, respectively.

Water sampling for pesticide analysis from the horizontal screens started in April 2012 (half a year after installation) and is only conducted when the soil media surrounding the screens is saturated.

The design of the wells facilitates the possibility of collecting water from six points along the 12 m long well, but this option is currently not used.

## Appendix 9

### Groundwater age from recharge modelling and tritium-helium analysis

The field investigations carried out at the various PLAP fields offer a good opportunity to model the groundwater age from soil porosity and net precipitation assuming simple piston flow for groundwater.

For obvious reasons, it would be advantageous to be able to compare groundwater age obtained by recharge modelling and soil porosities with groundwater age obtained by other methods.

Other methods for age dating of young groundwater are based on natural or anthropogenic tracers including tritium-helium ( $^3\text{H}/^3\text{He}$ ), chlorofluorocarbons (CFCs), and sulphurhexafluoride ( $\text{SF}_6$ ). Preliminary studies using the latter two methods were, however, unable to produce sufficiently accurate results to permit direct comparison, due to:

- Decline in atmospheric CFCs over the last two decades and
- Difficulties in determining the amount of excess air entering groundwater due to dynamic change in groundwater table.

The tritium-helium method was tested in 2010 at Jynde vad and Tylstrup.

The other fields were discounted because of:

- Low pumping rate excluded sampling for dissolved gases in clamped copper tubes and
- the piston flow model cannot be expected to be valid for the glacial clay till fields, making direct comparison of the two methods impossible.

#### Age from recharge modelling

Recharge data obtained by the MACRO model for 2000-2009 (Rosenbom et al., 2010) were used to estimate water velocity and groundwater age from the deepest screens at the Jynde vad and Tylstrup fields, Table A9.1. The deeper wells are normally only used for water level monitoring, and the wells were included to be able to extend the age interval. Porosity obtained from bulk density of 10 cm cores indicates a soil porosity of 0.43 at 0.5 m and deeper (Lindhardt et al., 2001).

The average water velocities during the last 2-3 years (prior to age-dating in 2010), which are probably more realistic for estimating groundwater age for the shallower filter sections were 1.42–1.60 m per year for Jynde vad and 1.35–1.38 m per year for Tylstrup. A water velocity of 1.4 m per year appears reasonable for estimating groundwater age at both fields based on recharge data. Groundwater age estimates using a water velocity of 1.4 m per year for all filter sections, except for the deep one at Tylstrup (1.1 m per year) are compared with groundwater age estimated by the tritium-helium method (Figure A9.1).

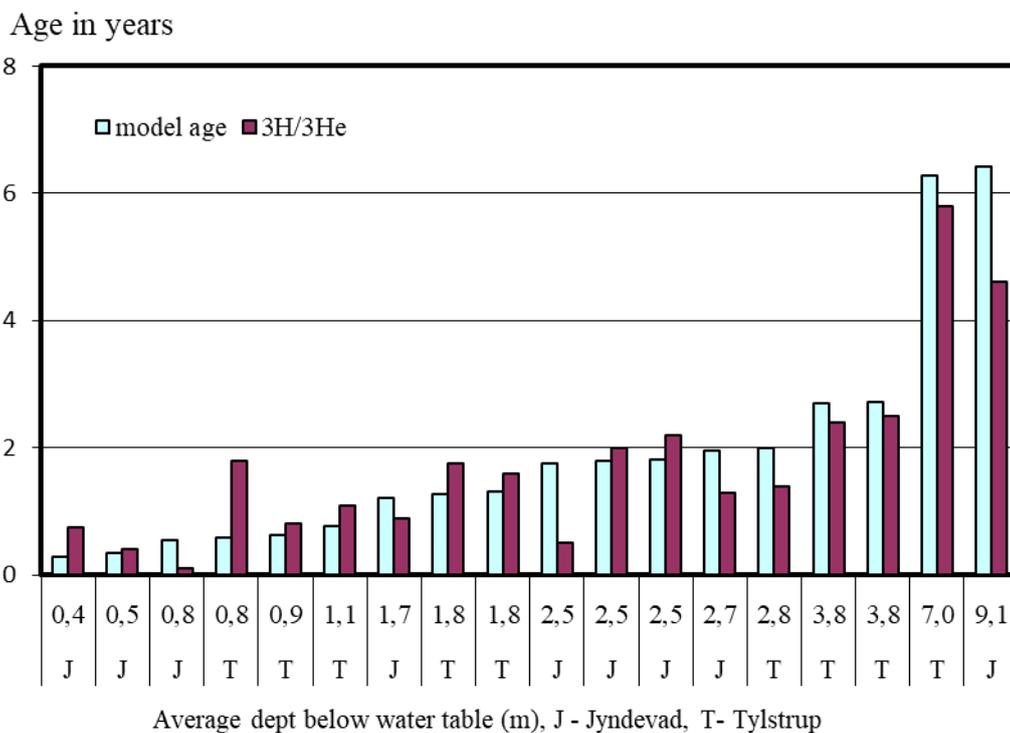
**Table A9.1. Average recharge 2000-2009, water velocity and groundwater age.**

Location	Recharge mm/year	Porosity	Velocity m per year	Water Table m b.s.	Fiter depth m b.s.	Age m per year
Jynde vad	613	0.43	1.43	2.5	11.5	6.3
Tylstrup	477	0.43	1.11	4.5	11.5	6.3

#### Age from tritium-helium analysis

Samples for tritium and helium collected in one liter plastic bottles and clamped copper tubes respectively were shipped to the University of Bremen and analysed according to Sültenfuß *et al.* (2009). The age of water was determined from the ratio between tritium ( $^3\text{H}$ ), half-life of 12.5 years, and its daughter product helium-3 ( $^3\text{He}$ ) in the water.

The tritium-helium age and the recharge model age differ less than one year for most wells over the entire depth interval and no systematic difference in age can be observed (Figure A9.1). Wells including both fields are shown with increasing depth from left to right in Figure A9.1. The depths are meters below water table to the mid-screen. The length of each screen is 1 m, meaning that the water table was 10 cm below top-screen for the shallowest depth indicated in the figure. Depth of water table checked during pumping did not indicate problems with intake of air, and no bubbles were observed during sampling.



**Figure A9.1.** Groundwater age at Jynde vad and Tylstrup. Recharge model age assumes water velocity of 1.4 m per year, except for the deep filter section at Tylstrup (1.1 m per year).

Minor difference in groundwater age determined by recharge modelling and tritium-helium analysis is expected due to the analytical uncertainty regarding tritium and helium. Furthermore, groundwater velocity may vary due to local variations in porosity and permeability affecting the depth of iso-age lines below water table. Given these uncertainties, it is concluded that the model age and the tritium-helium age are consistent.