

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 under field conditions. The objective of the PLAP is to improve the scientific foundation for decision-making in the Danish regulation of pesticides. The specific aim is to analyse whether pesticides applied in accordance with current regulations leach to groundwater in unacceptable concentrations. The programme currently evaluates the leaching risk of 42 pesticides and 41 degradation products at five agricultural sites ranging in size from 1.1 to 2.4 ha. The evaluation is based upon monitoring results representing detections in 1 meters depth (water collected via drains and suction cups) and detections in groundwater monitoring screens (1.5-4.5 meter below ground surface, hereafter m b.g.s.). This report presents the results for the entire monitoring period May 1999–June 2010. Results covering part of the period May 1999–June 2009 have been reported previously.

Highlights from **monitoring period 2009-2010** where **6** pesticides were applied, show that:

- Bifenox acid (degradation product of bifenox) can on loamy soil leach through the root zone and enter both drainage water system and groundwater monitoring wells in concentrations exceeding 0.1 µg/l. Average concentration in the drainage water exceeded 0.1 µg/l and concentrations exceeding 0.1 µg/l were observed up to six months after application. Similar evidence of pronounced leaching was **not** observed on the coarse sandy soil as there was only a single detection of bifenox acid in soil water, whereas bifenox was detected very sporadically in soil and groundwater, concentrations always less than 0.1 µg/l.
- Ethofumesate, this year used in a new admissible dose that is five times lower than in past applications, was detected once in groundwater, concentrations at less than 0.1 µg/l. When, in the past (before the imposed regulation), ethofumesate was used at a much higher dose, leaching above 0.1 µg/l to both drains and groundwater monitoring wells was observed.
- Metamitron, this year (2009) used in the maximum allowed dosage and previous year (2008) in a dose 33% lower than the permitted, did not cause leaching above 0.1 µg/l of neither metamitron nor its metabolite metamitron–desamino. This leaching pattern differs from previous observations (2000, 2001 and 2003) where metamitron, used at maximum allowed dose, together with its metabolite metamitron-desamino leached above 0.1µg/l to both drains and groundwater monitoring wells.
- The leaching pattern of the remaining three pesticides (bentazone, azoxystrobin, triasulfuron) was in line with the previous observations (outlined below).

Dansk sammendrag

I 1998 vedtog Folketinget at iværksætte projektet ”Varslingssystem for udvaskning af Pesticider til grundvandet” (VAP). VAP er et omfattende monitoringsprogram, der undersøger udvaskning af pesticider anvendt i landbrug under reelle markforhold. Programmet har til formål at undersøge, om godkendte pesticider eller deres nedbrydningsprodukter – ved regelret brug – udvaskes til grundvandet i koncentrationer over grænseværdien for herigennem at udvide det videnskabelige grundlag for danske myndigheders (Miljøstyrelsen) procedurer for regulering af sprøjtemidler. Udvasningsrisikoen for 42 pesticider og 41 nedbrydningsprodukter er således op til i dag undersøgt på fem marker, der har en størrelse på mellem 1,1 og 2,4 ha. Undersøgelsen bygger på monitoringsresultater henholdsvis repræsenterende fund i en meters dybde (indhentet via dræn og sugeceller) og fund i grundvandsmoniteringsfiltre (1.5-4.5 meter under terræn, herefter m u.t.). Denne rapport opsummerer resultaterne for den samlede monitoringsperiode maj 1999 – juni 2010; resultater fra de foregående år maj 1999 – juni 2009 er blevet afrapporteret i de tidligere rapporter.

”Highlights” fra den seneste monitoringsperiode **2009-2010**, hvor **6** pesticider blev udbragt, viser følgende:

- Bifenox-syre (nedbrydningsprodukt af bifenox) blev på lerjorde udvasket fra rodzonen (1 m.u.t.) til både dræn og grundvandsfiltre i koncentrationer over 0,1 µg/l. I dræne oversteg den årlige middelkoncentration 0,1 µg/l, og i grundvandsfiltrene blev der på en ud af to testede lerjorde fundet koncentrationer over 0,1 µg/l op til seks måneder efter udbringning. Tilsvarende udvaskning blev ikke set på den grovsandede jord, hvor der kun var et enkelt fund af bifenox-syre (i jordvandet) samt sporadiske fund af bifenox i lave koncentrationer (under 0,1 µg/l).
- Ethofumesat, der som følge af Miljøstyrelsens restriktioner dette år blev udbragt i en dosis 5 gange lavere end tidligere, blev denne gang kun fundet i en enkelt prøve (<0,1 µg/l). Ved tidligere anvendelser med den høje dosering, blev ethofumesat udvasket til både dræn og grundvandsfiltre i koncentrationer over 0,1 µg/l.
- Hverken metamitron, som dette år (2009) blev udbragt i maksimalt tilladte dosis og sidste år (2008) i en dosis, der var 33 % mindre end det tilladte, eller metabolitten metamitron-desamino, blev udvasket i koncentrationer, der oversteg 0,1 µg/l. Udvasningsmønsteret var dermed forskelligt fra tidligere observationer (2000, 2001 og 2003), hvor både metamitron (anvendt i den maksimalt tilladte dosis) sammen med metabolitten metamitron-desamino blev udvasket i koncentrationer, der oversteg 0,1 µg/l i både dræn og grundvandsfiltre.
- For de øvrige 3 stoffer (bentazon, azoxystrobin, triasulfuron) var de observerede udvasningsforløb meget lig tidligere observationer (beskrevet nedenfor).

Resultater for hele **monitoringsperioden 1999-2010**, som omfatter **42** pesticider viser følgende:

- Bentazone leached through the root zone (1 m b.g.s.) in average concentrations exceeding 0.1 µg/l in the drainage system at the loamy sites of Silstrup, Estrup, and Faardrup. Moreover, bentazone was frequently detected in the monitoring screens situated beneath the drainage system at Silstrup and Faardrup (Table 19 and 20). Apart from eight samples, however, concentrations detected were all below 0.1 µg/l. At Estrup leaching was mostly confined to the depth of the drainage system and rarely detected in deeper monitoring screens (Appendix 5). On the sandy soils, bentazone leached at Jyndevad, but was only detected once 1 m b.g.s. at Tylstrup. At Jyndevad high concentrations (exceeding 0.1 µg/l) were detected in the soil water samples from suction cups 1 m b.g.s. four months after application. Thereafter, leaching diminished and bentazone was not subsequently detected in the monitoring wells. Although leached in high average concentrations (>0.1 µg/l) at four sites, bentazone was generally leached within a short period of time. Initial concentrations of bentazone were usually very high, but then decreased rapidly. In general, concentrations exceeding 0.1 µg/l were only found within a period of one to four months following the application. The degradation product AIBA was detected twice in the vadose zone at Jyndevad, once in drainage water at Estrup and Faardrup (Table 18), and once in water from a horizontal well at Estrup (Table 20).
- Bifenox acid (degradation product of bifenox) leached through the root zone and entered the drainage water system in average concentrations exceeding 0.1 µg/l at the loamy sites of both Silstrup and Estrup. While leaching at Estrup seems to be confined to the depth of the drainage system, leaching to groundwater monitoring wells situated beneath the drainage system was observed at Silstrup, where concentrations exceeding 0.1 µg/l were observed up to six months after application.. Similar evidence of pronounced leaching was **not** observed on the coarse sandy soil as there was only a single detection of bifenox acid in soil water, whereas bifenox was detected very sporadically in soil and groundwater, concentrations always less than 0.1 µg/l.
- In the loamy soil of Estrup, ethofumesate, metamiltron, and its degradation product metamiltron-desamino leached through the root zone (1 m b.g.s.) into the drainage water in average concentrations exceeding 0.1 µg/l (Table 17). The compounds have not been detected in deeper monitoring screens. These compounds also leached 1 m b.g.s. at the Silstrup and Faardrup sites, reaching both the drainage system (Table 17 and 18) and groundwater monitoring screens (Table 19 and 20). Average concentrations in drainage water were not as high as at Estrup, although concentrations exceeding 0.1 µg/l were observed in both drainage water and groundwater monitoring screens during a 1–6-month period at both Silstrup and Faardrup (see Kjær *et al.*, 2002 and Kjær *et al.*, 2004 for details). The above leaching was observed following an application of 345 g/ha of ethofumesate and 2,100 g/ha of metamiltron in 2000 and 2003. Since then, ethofumesate has been regulated and the leaching risk related to the new admissible dose of 70 g/ha was evaluated with the two recent applications (2008 at Silstrup and 2009 at Faardrup). Although metamiltron has not been regulated, a reduced dose of 1400 g/ha was applied at one of the two recent applications, namely that at Silstrup in 2008. The leaching following these recent applications (2008 at Silstrup and 2009 at Faardrup) was minor. Apart from a few samples from the drainage system and groundwater monitoring wells containing less than 0.1 µg/l,