The fate and behaviour of Isoproturon, Cypermethrin, Diazinon and Azoxystrobin in four soils

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1. Introduction:

Pesticides are considered to be the major source of diffuse pollution in soil therefore knowledge of the fate and behaviour of pesticide compounds is vital for registration and risk assessment purposes. Extractability of pesticides has been reported to diminish with increasing contact time, residues sequestered within the soil matrix could cause chronic pollution in the environment.

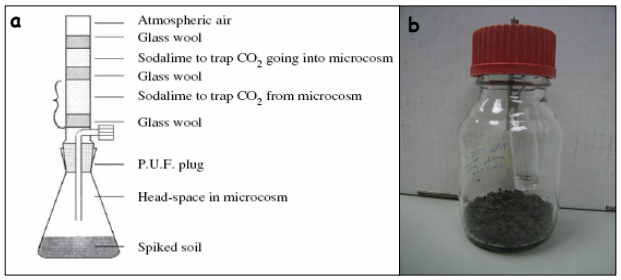
2. Aims:

- To observe the fate and the behaviour of the pesticides Isoproturon (IPU), Cypermethrin (CYP), Diazinon (DIA) and Azoxystrobin (AZO) in four soils.
- To investigate changes in the chemical extractability of the three pesticides over time using three different extraction techniques.
- To investigate the catabolic activity of the indigenous microflora of the four soils.

3. Methods:

- The selected soils had organic matter contents ranging from 1.6% to 6.5% and pH from 5.8 to 7.3.
- Soils were spiked with ^{12}C-Pesticides, mixed with the corresponding ^{14}C-analogue and then incubated at 20 °C in the dark in specially constructed microcosms (Figure 1a). Soils were sampled at 1, 10, 20, 50 and 100 d.
- $^{14}CO_2$ and ^{14}C-volatile compounds were trapped in Carbosorb and PUF plugs respectively.
- Soil samples were extracted using $CaCl_2$, acetonitrile or hydroxypropyl-β-cyclodextrin, by 24 hours shake extraction.
- Catabolic activity of the soils was measured over a 10 day (240 h) incubation time using respirometers (Figure 1b).

Figure 1: a) Microcosm and b) respirometer set up



4. Findings:

4.1. Losses from the soil:

- Losses from the microcosm are shown for all the pesticides in all soils (Figure 2).
- Azoxystrobin suffered the least losses overall.
- Volatile compounds were trapped in PUF plugs in the case of soil spiked with Diazinon only.

4.2.Extractability:

- Pesticide behaviour was variable in different soils.
- Pesticide extractability diminished after 100 d of incubation.
- Cypermethrin was the most persistent of the pesticides.
- Figure 3 shows the diminishment of the extractability of the four pesticides in one of the soils (Redesdale soil).

4.3. Mineralisation:

- Indigenous microorganisms were able to degrade the pesticides to some extent.
- Total mineralisation was less than 15% in most soil-pesticide systems.
- Diazinon mineralisation was favoured Redesdale soil (Table 1).
- Mineralisation decreased after 100 d incubation in all cases.

Table 1: Total mineralisation after 10 d incubation of four pesticides in Redesdale soil

Time (days)	Isoproturon (% mineralisation ±s.d)	Cypermethrin (% mineralisation ±s.d)	Diazinon (% mineralisation ±s.d)	Azoxystrobin (% mineralisation ±s.d)
0	2.37 ±0.6	14.31 ±3.0	22.35 ±3.0	5.73 ±0.2
12	3.81 ±0.2	19.05 ±0.9	45.99 ±0.7	8.67 ±0.5
22	4.66 ±0.3	25.14 ±1.2	52.60 ±6.0	6.70 ±0.3
50	5.86 ±0.2	5.20 ±0.8	46.05 ±3.9	4.37 ±0.1
100	3.41 ±0.2	2.98 ±0.2	7.90 ±0.4	3.07 ±0.1

Figure 2: Pesticide losses in four soils during 100 d incubation in microcosms

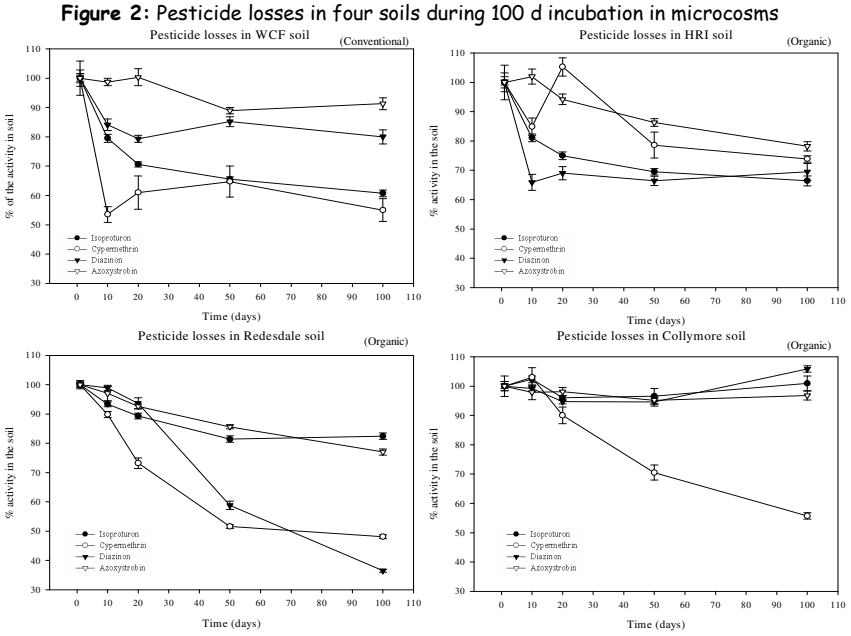
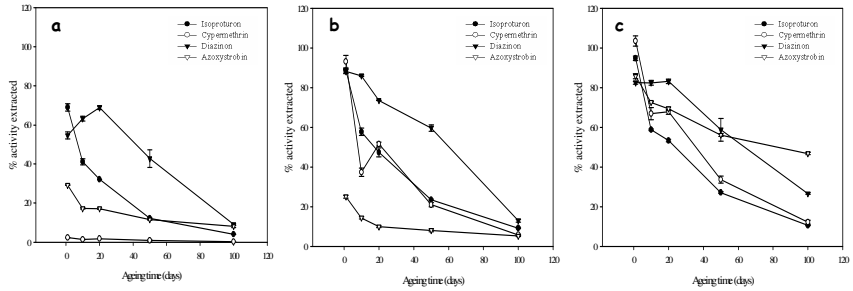


Figure 3: Extractability of the four pesticides from the Redesdale soil using a) CaCl2 (0.01M), b) Acetonitrile and c) Hydroxypropyl-β-cyclodextrin (0.05M)



5. Conclusions:

- Increasing the pesticide-soil contact time results in decreases in the extractability of the pesticides as well as a commensurate increase in the formation of non-extractable residues.
- Relatively polar compounds (i.e. Isoproturon, Diazinon, Azoxystrobin) formed a considerable amount of bound residues soon after application.
- Complexity of the soil-pesticide system was apparent. Fate and behaviour of pesticide compounds varied among soil-pesticide systems. Any attempt to predict the fate and behaviour of any chemical in the soil should take place from a holistic point of view.
- Catabolic activity in the organic soils was generally low.