EXPERIMENTS IN MINI-LYSIMETERS FOR ANALYSING THE VERTICAL MOVEMENT OF LINDANE IN FOREST HUMUS

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Problem

Undisturbed soil samples of mull and moor humus were chosen to examine the different leaching behaviour of lindane (γ-HCH) in mini-lysimeters.

Samples

Undisturbed samples were taken from a typical mull and moor humus profile in the Fichtelgebirge (NE-Bavaria). The characteristics of forest humus forms and lysimeters are described in Table 1.

Methods

Undisturbed soil samples (15 cm thick) in mini-lysimeters (0 = 12 cm) of glass were placed in a green house at a temperature of 17°C. The lysimeters were irrigated once a week with 213 ml aqua bidest., according to the annual rainfall of the Fichtelgebirge.

Lindane was applied once (107 µg), dissolved in the irrigation water, corresponding to a concentration of 100 gha^{-1}, usual in forestry. Ten hours after irrigation the lysimeters were desiccated with 100 hPa for one hour in order to produce water tension. Control lysimeters were treated similarly, but without application of lindane. Two replicates were run for each treatment.

The percolate was shaken in a separatory funnel with 3x100 ml hexane for three minutes each. Foam and emulsion, due to high amounts of dissolved organic carbon (DOC), could be partly removed by suction. After drying of the extract over Na_2SO_4 and reduction to a few ml with the rotary evaporator it was cleaned over Florisil (4% H_2O, 60-100 mesh) and eluted with a 200 ml hexane. The eluate was subsequently dried under N_2 and dissolved in a final volume of 0.1 ml-5.0 ml hexane. Lindane was analysed with a GC-ECD and quantified using aldrin as internal standard. Recovery of lindane was 98%-107% for the mull and 86%-92% for the moor humus.

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Table 1: Characterization of forest humus forms

humus form/horizon		Thickness (cm)	pH ($CaCl_2$)	$CaCO_3$ (%)	C_{org} (%)
mull	L	0,5	8,1	traces	38,8
	Ah	14	7,9	19	4,1
mor	L	0,5	3,2	0	50,4
	Of	3	3,0	0	50,2
	Oh	5	2,8	0	47,8
	Aeh	6	2,8	0	5,6

lysimeter/ percolate	mull		mor	
	control	treatment	control	treatment
DOC (mg l^{-1})	69	59	158	221
pH	8,5	8,4	3,4	3,5
org.Carbon (g) in lysimeter	37,1	24,6	123,4	120,1

Table 2: Lindane concentrations in percolates of lysimeters after application

date	mull		mor	
	A (ng)	B (%)	A (ng)	B (%)
26.04.88	16.411,3	15,34	2.887,8	2,70
03.05.88	1.066,7	16,33	1.276,0	3,90
10.05.88	214,3	16,54	235,5	4,11
17.05.88	63,9	16,60	73,6	4,18
25.05.88	16,9	16,62	35,0	4,22
31.05.88	15,3	16,63	15,4	4,23
07.06.88	8,1	16,64	7,0	4,23
14.06.88	13,4	16,64	5,8	4,24
21.06.88	13,8	16,66	4,3	4,25
27.06.88	15,7	16,68	3,2	4,25

A= γ-HCH in absolute amount of percolate (in ng)
B= Cumulative amount (in % of applied amount of γ-HCH)

Results and Discussion

From Table 2 it is clear that the movement of lindane through mull and moor humus forms is different considering the total amounts of lindane leached through the soil. In the mull humus lysimeters 16.68%, in the moor humus lysimeter 4.25% of the total amount applied are leached. An important quantity of lindane passes the soil in the first day of application, because of lindane application in dissolved form. The higher sorption capacity of the moor humus can be explained by the higher amounts of organic carbon in three lysimeters (Table 1). Because of the high contents of thick roots in the mull Ah, mass flow predominates sorptive processes of the soil organic matter. The mass flow effect is especially pronounced directly after the application date.

Figure 1 shows the lindane concentration related to the volume of percolate. The effect of the single lindane application is observed in the percolates for about five weeks. Significant amounts (13 ng l^{-1}-124 ng l^{-1}), about ten times more of what has been found in the control (3 ng l^{-1}-13 ng l^{-1}) were leached through the soil, also after the decay of the application effect. Each irrigation probably induces new sorption- and desorption-processes and causes the movement of lindane.

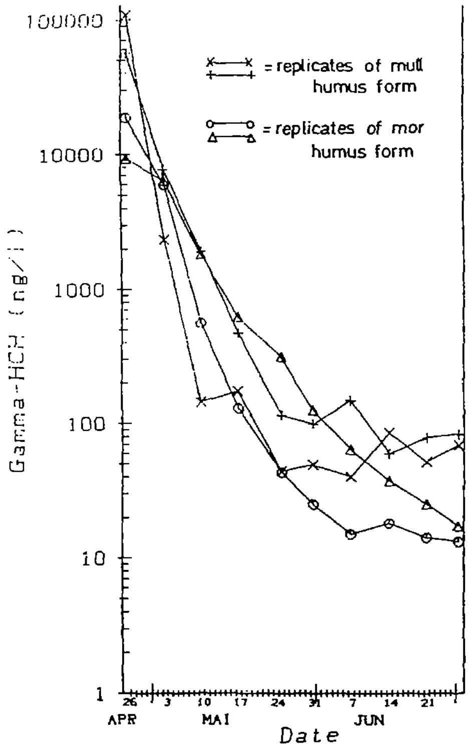

Fig. 1: Lindane concentration in percolates of lysimeters after application