DISSIPATION OF DIURON, LINURON AND ISOURON IN THE SOIL

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The degradation rate of pesticides in soil and their adsorption kinetics are important factors for assessing the groundwater contamination potential. In this study, experiments were performed on: (1) dissipation of herbicides in three soils with different temperature and moisture conditions, (2) dissipation of herbicides in sterilized soil, (3) isothermal sorption through the batch equilibrium technique, (4) mobility in soil columns experiments with sieved soil. Subsequently the possibility of groundwater contamination by these herbicides was also assessed with the behavior assessment model (BAM) and the groundwater pollution potential model (GWP).

Dissipation of three herbicides (diuron, linuron and isouron) in three different soils (shihtou series, shuipientou series and futoulun series Table 1) with three different temperatures (10, 25 and 40℃) and moistures (30, 60 and 90% Field Capacity) was studied. Adsorption isotherms of three herbicides on soils were determined using the batch test (Table 2). Movement of herbicides in the soil column and dissipation in sterilized soil were also determined. The possibility of groundwater contamination was assessed with the behavior assessment model (BAM) and groundwater pollution potential model (GWP). The DT_{50} (50% degraded time) ranged from 42 to 76 days for diuron, 28 to 33 days for linuron and 34 to 106 days for isouron in different soils at 40℃ under soil moisture of 90% Field capacity. DT_{50} values were higher in sterilized soil than in non-sterilized soil (Table 3 and 4). The biodegradation may be an important pathway for dissipation of three herbicides in soil. Model calculations isouron in Futoulun soil showed that this substance may rapidly leach to groundwater at three meter depth. Using two screening models to evaluate the possible leaching of the three herbicides, diuron, linuron and isouron into groundwater in three study soils, the results indicate that neither of the herbicides can contaminate the groundwater under the local conditions (Table 5 and 6).

Table 1. Properties of the soil in the experiment.

Soil	Soil texture	Sand	Loam	Clay	pH	Bulk density	Field	Organic carbon
		----------(%)----------				(g/cm^3)	capacity(%)	fraction(%)
St	Sandy loam	59	11	30	4	1.37	11.9	0.54
Spt	Loam	36.6	25.4	38	4.47	1.14	33.19	1.41
Ftl	Loam	35	24	41	6.37	1.16	31.08	1.13

Table 2. Sorption coefficients of three herbicides at various temperature and on different soils

Temp.(℃)	K_d(μg/g)								
	Diuron			Linuron			Isouron		
	St	Spt	Ftl	St	Spt	Ftl	St	Spt	Ftl
25	14.8	14.3	15.9	17.9	23.7	26.9	0.68	1.65	0.72
37	13.7	17.2	25.9	20.7	26.6	24.3	0.98	1.42	1.21

Table 3. Dissipation coefficient(K) and Half-life($T_{1/2}$) of Diuron, Linuron, Isouron in soils under different conditions

	Temp	St			Spt			Ftl		
Herbicide	(℃)	$K(day^{-1})$	$t_{1/2}$(day)	R^2	$K(day^{-1})$	$t_{1/2}$(day)	R^2	$K(day^{-1})$	$t_{1/2}$(day)	$^aR^2$
Diuron	10	0.000504	1376.2*	0.2878	0.002448	283.2*	0.474	0.000875	792.3*	0.2894
	25	0.002489	278.5*	0.7374	0.007932	87.4	0.9482	0.004343	159.6*	0.911
	40	0.010463	66.2	0.9452	0.016227	42.7	0.8991	0.008703	79.6	0.9215
Linuron	10	0.003192	217.1*	0.7982	0.003784	183.2*	0.8606	0.004018	172.5*	0.8736
	25	0.004997	138.7*	0.8485	0.00998	69.5	0.9384	0.008838	78.4	0.9391
	40	0.019982	34.7	0.9415	0.023956	28.9	0.9787	0.019264	36	0.9605
Isouron	10	0.000739	937.4*	0.2083	0.001351	513.0*	0.6444	0.001702	407.2*	0.5926
	25	0.003034	228.5*	0.6047	0.00352	196.9*	0.8337	0.005639	122.9	0.8253
	40	0.010054	68.9	0.9236	0.008363	82.9	0.9503	0.025825	26.8	0.9859

Table 4. Dissipation coefficient(K) and Half-life($T_{1/2}$) of herbicide in sterilized soils

Herbicide	St			Spt			Ftl		
	$K(day^{-1})$	$t_{1/2}$(day)	$^aR^2$	$K(day^{-1})$	$t_{1/2}$(day)	$^aR^2$	$K(day^{-1})$	$t_{1/2}$(day)	$^aR^2$
Diuron	0.00312	222.5	0.8842	0.01046	66.3	0.9253	0.01049	66.1	0.8033
Linuron	0.01193	58.1	0.9133	0.01231	56.3	0.9286	0.0163	42.5	0.8334
Isouron	0.00564	122.9	0.7149	0.00657	105.5	0.9149	0.00628	110.4	0.8497

Table 5. Relative fate of three herbicides in soils simulated by using BAM

Soil	Herbicide	Volatilized	Degraded	Remaining
		----------%----------		
St	Diuron	0	26.96	73.04
	Linuron	0	45.08	54.92
	Isouron	0	9.57	90.43
Spt	Diuron	0.04	38.54	61.42
	Linuron	0	51.3	48.7
	Isouron	0	8.02	91.98
Ftl	Diuron	0.03	22.98	76.99
	Linuron	0	43.88	56.12
	Isouron	0	22.79	77.21

Table 6.Travel time and resisual mass percent to H=10m or 3m of three soils for three herbicides

Soil	Herbicide	3m	
		RESIDUAL MASS (%)	TIME TO GW (yr)
St	Diuron	0	38.089
	Linuron	0	45.961
	Isouron	13.57	1.959
Spt	Diuron	0	21.373
	Linuron	0	34.958
	Isouron	9.14	2.823
Ftl	Diuron	0	23.973
	Linuron	0	40.289
	Isouron	2.14	1.467