DISSIPATION OF HERBICIDE OXYFLUORFEN IN SUBTROPICAL SOILS AND ITS POTENTIAL TO CONTAMINATE GROUNDWATER

Wey-Shin Sheu, Jui-Hung Yen and Yei-Shung Wang

Department of Agricultural Chemistry, National Taiwan University, Taipei, Taiwan

The dissipation and mobility of herbicide oxyfluorfen in field soil was investigated in the laboratory with six tea garden soils of Taiwan. The dissipation coefficients of the oxyfluorfen in soils at different moisture contents (30, 60 and 90% of soil field capacity) and soil temperatures (10, 25 and 40) were studied by determining the degradation and adsorption of oxyfluorfen in the soils. Soil was sampled on 0 (3 hrs after application of herbicide), 1, 2, 4, 6, 8 and 13 weeks after application of oxyfluorfen for degradation determination. Residues of oxyfluorfen in soil was extracted by acetonitrile and detected with HPLC. Adsorption of oxyfluorfen in soils were performed by adding 1 g air dry soil to the water containing 0, 0.03, 0.04, 0.05, 0.06 and 0.07 mg/L of oxyfluorfen, separately, and shaking for 4 hrs under 25 and 37, separately. The supernatant was extracted by dichloromethane + *n*-hexane (1:1), and oxyfluorfen was analyzed by HPLC. The mobility of oxyfluorfen was studied by leaching the herbicide in a soil column in the laboratory.

Results indicated the half-life of oxyfluorfen were from 72 to 160 days for six tea garden soils. The higher the temperature, the rapid dissipation rate was found, and almost no dissipation was found at 10 .(Table 1.) Adsorption coefficient (K_d) of oxyfluorfen in six soils were found from 52 to 755 μg/g (25) and 111 to 829 μg/g (37). (Table 2) Leaching experiments showed about 70% of applied chemicals were remained in the soil and most of residues were in the upper 3 cm depth of soil column. No oxyfluorfen was found at the depth greater than 9 cm. (Fig 1) The possible contamination of groundwater by the herbicide oxyfluorfen was assessed using the behavior assessment model (BAM) and the groundwater pollution-potential model (GWP). Evaluating the residue and travel time using the GWP model, the results illustrated that the mobility of oxyfluorfen in soil is not very fast and may not lead to contamination of groundwater under normal conditions in the subtropical area. (Fig 2 & 3)

Table 1. The half-life of oxyfluorfen in soils at different conditions

Soil	Temp( )	WHC(%)	μ	R	$T_{1/2}$(day)
Ttk-ta	40	90	0.0101	0.9668	68.66
		60	0.0069	0.8556	100.59
		30	0.0063	0.8743	110.85*
	25	90	0.0063	0.4987	109.21*
		60	0.0043	0.9603	160.25*
		30	0.0029	0.8425	242.19*
	10	90	0.0004	0.4192	1898.15*
		60	-	-	-
		30	-	-	-
Ttk-tb	40	90	0.0124	0.8948	56.04
		60	0.0118	0.9274	58.83
		30	0.0129	0.8604	53.76
	25	90	0.0057	0.9212	121.36*
		60	0.0049	0.6964	142.13*
		30	0.0054	0.7788	129.51*
	10	90	-	-	-
		60	-	-	-
		30	-	-	-

Soil	Temp ( )	WHC(%)	μ	R	$T_{1/2}$(day)
Ttk-fa	40	90	0.0081	0.4757	85.42
		60	0.0065	0.7607	106.15*
		30	0.0065	0.5413	107.27*
	25	90	0.0041	0.5334	168.73*
		60	0.0045	0.8361	155.38*
		30	0.0049	0.8136	142.09*
	10	90	0.0005	0.0128	1322.26*
		60	0.0007	0.1085	1012.70*
		30	0.0031	0.7394	221.07*
Ttk-fb	40	90	0.0182	0.9535	38.11
		60	0.0181	0.9545	38.29
		30	0.0220	0.9264	31.54
	25	90	0.0061	0.8095	113.78*
		60	0.0072	0.9415	96.45
		30	0.0054	0.9507	127.58*
	10	90	-	-	-
		60	-	-	-
		30	-	-	-

Soil	Temp( )	WHC (%)	μ	R	$T_{1/2}$(day)
Ske	40	90	0.0167	0.5660	41.49
		60	0.0162	0.7906	42.83
		30	0.0209	0.7929	33.10
	25	90	0.0145	0.8699	47.81
		60	0.0095	0.6960	72.80
		30	0.0085	0.8448	81.31
	10	90	0.0033	0.8843	207.50*
		60	-	-	-
		30	-	-	-
Pc	40	90	0.0401	0.3517	17.29
		60	0.0150	0.8544	46.09
		30	0.0108	0.7040	64.17
	25	90	0.0471	0.4235	14.71
		60	0.0060	0.8742	114.59*
		30	0.0040	0.0904	171.43*
	10	90	0.0003	0.0480	2060.23*
		60	-	-	-
		30	-	-	-

Table 2. The Kd values of oxyfluorfen in soils at 25 and 37

	25		37	
	K_d	R-square	K_d	R-square
Ttk-ta	613	0.998	763	0.986
Ttk-tb	463	0.933	668	0.975
Ttk-fa	421	0.961	484	0.990
Ttk-fb	151	0.995	172	0.991
Ske	52	0.901	111	0.991
Pc	755	0.975	829	0.995

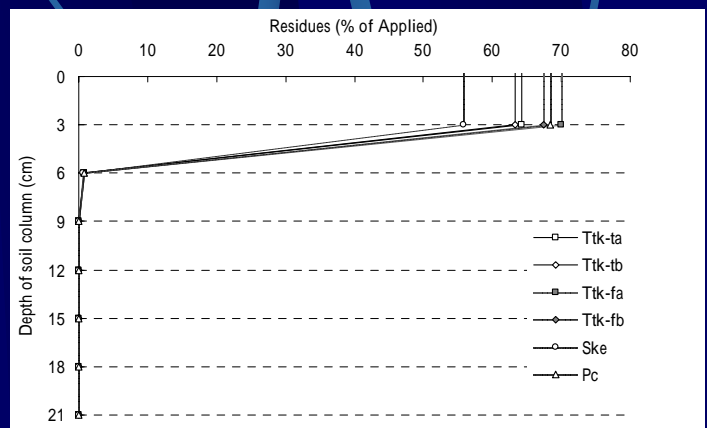Fig 1. Distribution of oxyfluorfen in various soil columns for 30 day.

Fig 2. The distribution of oxyfluorfen in the soil profile simulated by BAM model at 30 day after application
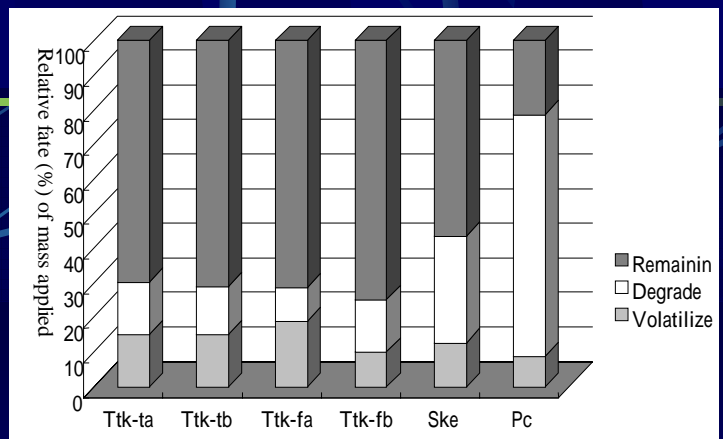

Fig 3. The relative fate of oxyfluorfen in the environment simulated by BAM model at 30 day after application