



ANALYSIS OF VEGETATION CONCENTRATIONS OF PCDD/F/PCBS FROM A COMMUNITY IN MICHIGAN, USA

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Introduction

- A central goal of the University of Michigan Dioxin Exposure Study was to determine the factors that explain variation in serum dioxin levels of PCDDs, PCDFs, and PCBs in the community around the Dow Chemical plant (Midland, Michigan, USA).
- Residential vegetation samples were included as one of the potentially explanatory factors.
- This poster describes the sampling methods and results of vegetation analysis conducted as part of the UMDES.

Methods

1. Populations in five geographic areas in Midland, Saginaw, Bay, Jackson, and Calhoun counties in Michigan, USA (Fig. 1) were sampled using a two-stage area probability household sample design.

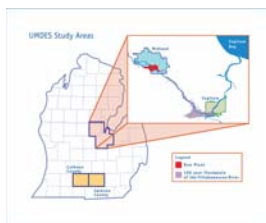


Fig. 1 Geographic Areas

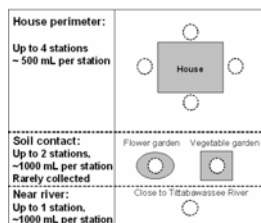


Fig. 2 Sampling Stations

- At each respondent's residence, up to seven soil and vegetation sampling stations were sampled in three sets: the house perimeter set, the soil contact set, and the near river set. Up to four stations were sampled in the house perimeter set, up to two stations in the soil contact set, and one station in the near river set. Vegetation was rarely collected from the soil contact set due to lack of availability.

- Each station was defined by the placement of a 3-foot diameter sampling ring on the ground. Approximately 500 mL of vegetation, typically grass, was collected from each station from the area within the sampling ring and placed in a Ziploc® bag (Fig. 3). Approximately 1000 mL were collected from the near river station.

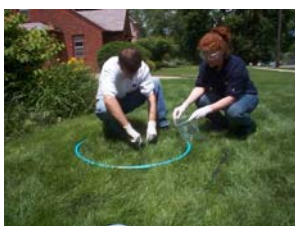


Fig. 3 Collecting Vegetation



Fig. 4 Amber Glass Sample Jars

- The samples were cut into 2-cm pieces and composited unwashed by set (house perimeter, soil contact, and near river), using a balance to ensure approximately equal masses from each station, and placed in dioxin-grade amber glass jars (Fig. 4).
- Vegetation samples were selected for analysis under either of two conditions: the property was in the Floodplain area or the analysis of the underlying soil sample yielded a value of greater than 8 pg/g TEQ.
- Analyses were performed by Alta Analytical Laboratory (El Dorado Hills, California, USA) for the WHO (1998) designated 29 PCDD, PCDF, and PCB congeners using US EPA methods 8290 and 1668.

Results and Discussion

PCDD, PCDF, and PCB concentration distribution in vegetation samples

- SAS statistical software was used to create a descriptive analysis of PCDD, PCDF, and PCB congener concentrations in the vegetation for each of the five geographic regions. The results were weighted by sampling probability.

Table 1. TEQs in Vegetation by Area

Zone	N	WHO 98 TEQ (pg/g dry weight)						
		Mean	S.E.	Median	75th %ile	95th %ile	Min.	Max.
M/S FP (NR)	163	62.9	21.1	3.6	16.4	291.9	0.2	2217.4
M/S FP (HP)	188	17.9	4.5	3.9	8.8	65.9	0.4	1892.3
M/S Near FP (HP)	69	493.4	464.4	3.8	12.5	202.7	0.6	10486.4
M/S Out FP (HP)	76	4.8	0.5	3.6	5.7	10.3	1.0	36.0
M Plume (HP)	31	45.4	17.2	19.5	34.4	132.7	0.9	336.9
J/C (HP)	52	5.2	0.7	3.7	7.5	10.8	0.7	33.1

M/S FP (NR) = Midland/Saginaw Floodplain (near river), M/S FP (HP) = Midland/Saginaw Floodplain (house perimeter), M/S Near FP (HP) = Midland/Saginaw Near Floodplain (house perimeter), M/S Out FP (HP) = Midland/Saginaw Outside Floodplain (house perimeter), M Plume (HP) = Midland Plume (house perimeter), J/C (HP) = Jackson/Calhoun (house perimeter).

- Table 1 shows that the highest median TEQ value is in the Plume area. The highest mean value is in the Near Floodplain area, however that value is driven largely by a pair of outlier values including the maximum vegetation TEQ value measured in the study. The highest 95th percentile value is the highest in the Floodplain area – near river samples.

Relationship with soil

- For each vegetation sample, the corresponding soil sample was also collected and analyzed. Figure 5 shows scatterplots of the relationship between soil and vegetation TEQs in the Floodplain near river and Plume house perimeter samples. Table 2 shows the statistics for the linear regression analysis. This analysis suggests that the TEQ for vegetation in the Floodplain is about 18% of the corresponding value in soil, whereas in the Plume, the TEQ for vegetation is about 36% of the corresponding value.

Fig. 5 Scatterplots Showing the Relationship Between Soil and Vegetation TEQs

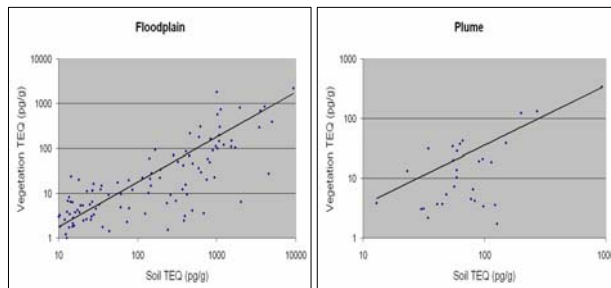
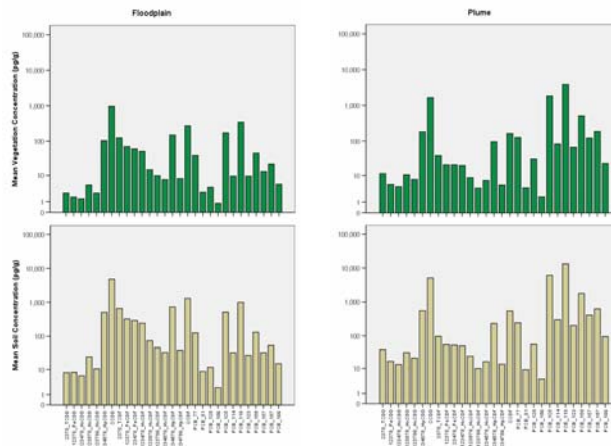


Table 2. Statistics for Relationship Between Soil and Vegetation

	Relation to soil	R ²	Number of samples
Floodplain	y=0.18x	0.53	163
Plume	y=0.36x	0.89	31

- In addition to comparing the TEQs between vegetation and soil, the congener profiles were compared. Figure 6 shows the mean value for each of the measured 29 congeners for the Floodplain near river samples and the Midland Plume house perimeter samples for both soil (in the gray) and vegetation (in the green). A comparison of the corresponding profiles indicates that the vegetation congener profiles are similar to those in soil.

Fig. 6 Comparison of Congener Profiles for Soil and Vegetation



Conclusions

- In the regions where soil TEQ levels are elevated, the Floodplain and the Plume, there is a strong relationship between the levels in soil and vegetation.
- The data suggest that there is a difference in the soil-vegetation relationship in the two areas. The vegetation concentrations in the Plume are higher relative to the soil concentrations than they are in the Floodplain. This difference may be related to soil characteristics, differences in vegetation type, or deposition mechanism (aerial in the Plume vs flooding in the Floodplain).
- The congener concentration profiles of the mean soil and mean vegetation samples for the floodplain and plume also correspond, specifically:
 - the furans are elevated in the floodplain samples;
 - and the dioxins and PCBs are elevated in the plume samples.
- Reproducibility for vegetation measurements was poorer than for soil measurements as the average relative percent difference for TEQ for the vegetation duplicates was 60% versus 15% for soil duplicates.

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