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Targeted analysis and Total Oxidizable Precursor assay of several insecticides for PFAS

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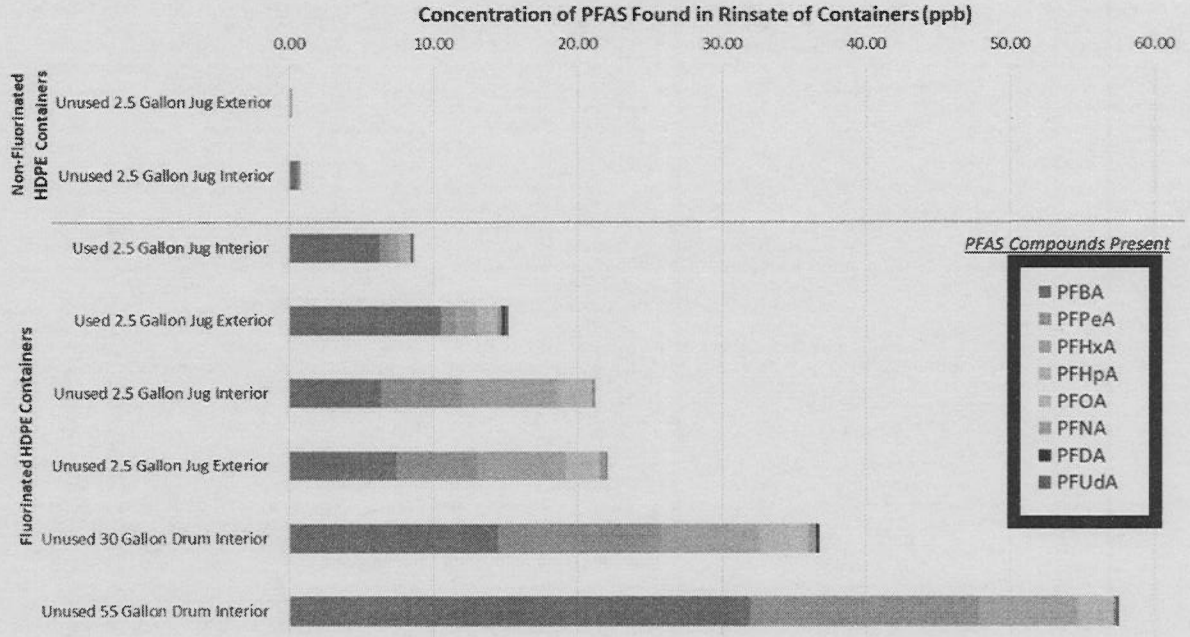
ABSTRACT

Targeted analysis for 24 Per- and Polyfluoroalkyl Substances (PFAS) was conducted on 10 insecticide formulations used on a United States Department of Agriculture crop research field. Perfluorooctane sulfonic acid (PFOS) was found in 6 of the 10 formulations with concentrations ranging from 3.92 to 19.2 mg/kg. Further analysis of soil and plant samples collected at the site found several additional PFAS, with PFOS being the most prominent. Suspect screening was then conducted on the formulations and provided several suspected PFAS in addition to the 24 targeted analyzed PFAS in 7 of the 10 samples, one of which showed no PFAS during targeted analysis. PFAS-precursor oxidation was then conducted on the two insecticide formulations with the greatest lists of suspected PFAS as validation of potential unknown PFAS in the formulations. This study revealed a previously unknown potential PFAS contamination source for rural and agricultural environments.

EPAs study of containers

Figure 1 - Levels of PFAS in rinsates from containers



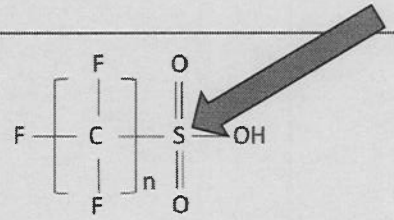
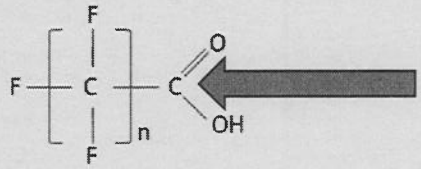
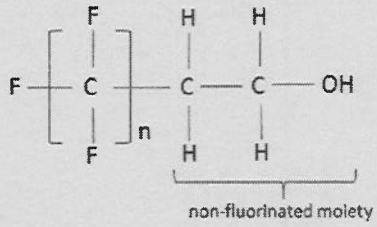
This results in a concentration of around 250 ppt PFOA in the insecticide

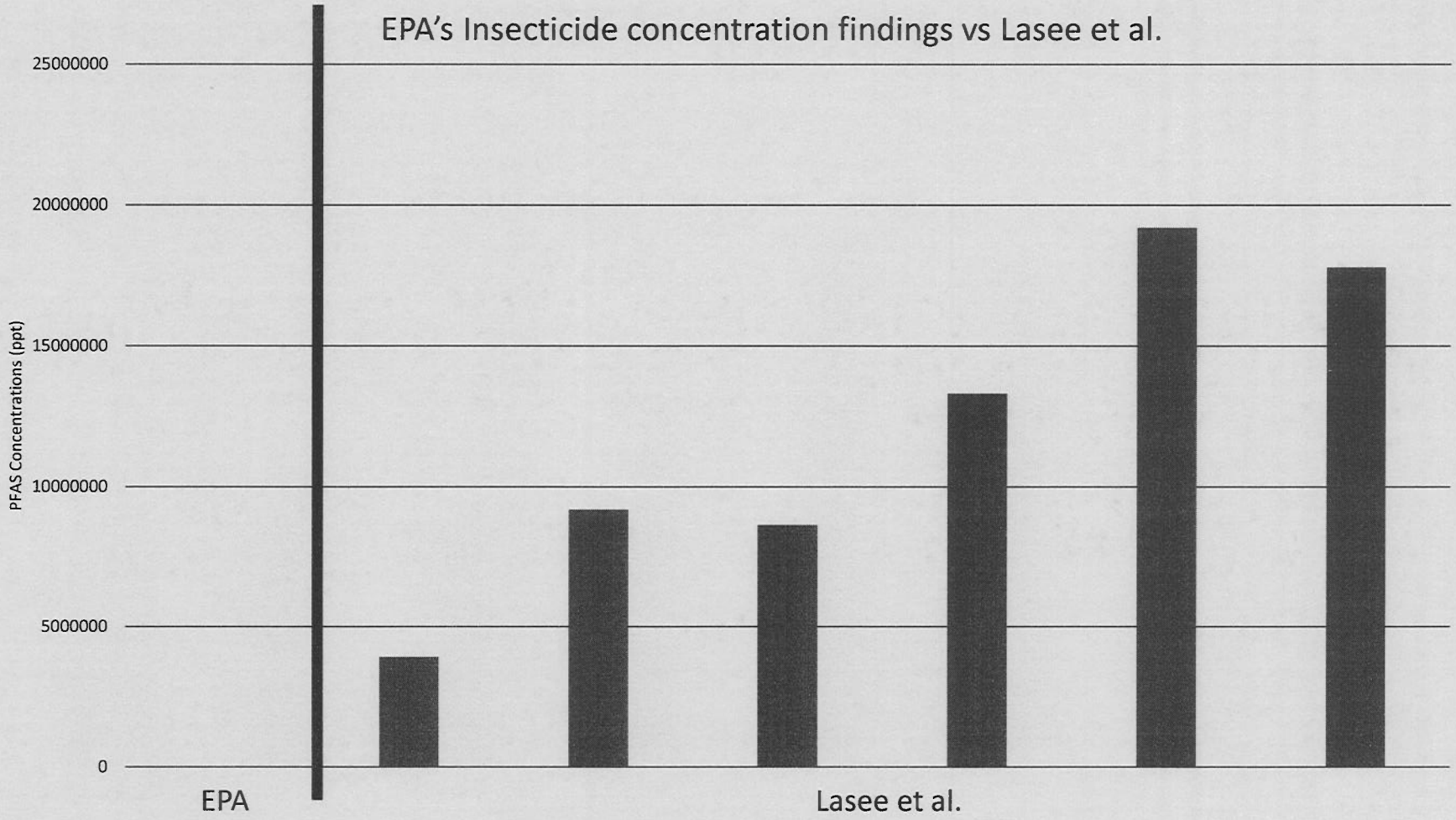
Findings of Lasee et al.

Table 1
Average concentration of PFOS in the analyzed insecticide formulations (mg PFAS/kg formulation or ppm, ± standard deviation). The concentrations reported were calculated from the dilution described previously in the "Insecticide Analysis section". PFAS with no concentrations above LOQ were not included in this table.

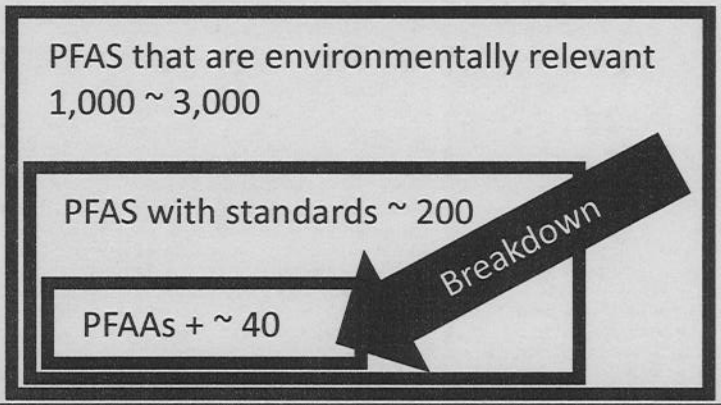
Sample ID	Formulation type	Active ingredient	PFOS (mg/kg)
1	Liquid concentrate	Abamectin	3.92 ± 0.51
2	Emulsified suspension	Novaluron	9.18 ± 0.34
3	Liquid concentrate	Mineral Oil (Petroleum oil)	8.64 ± 0.67
4	Emulsified suspension	Imidacloprid	13.3 ± 1.4
5	Emulsified suspension	Spiromesifen	19.2 ± 1.2
6	Liquid concentrate	Malathion	17.8 ± 0.7
7	Wettable powder	*Beauveria Bassiana*	0
8	Wettable powder	Pyridalyl	0
9	Emulsified suspension	Spinosad	0
10	Wettable powder	Spinetoram, Sulfoxaflor	0
BLANK			0

Differences in PFAS found

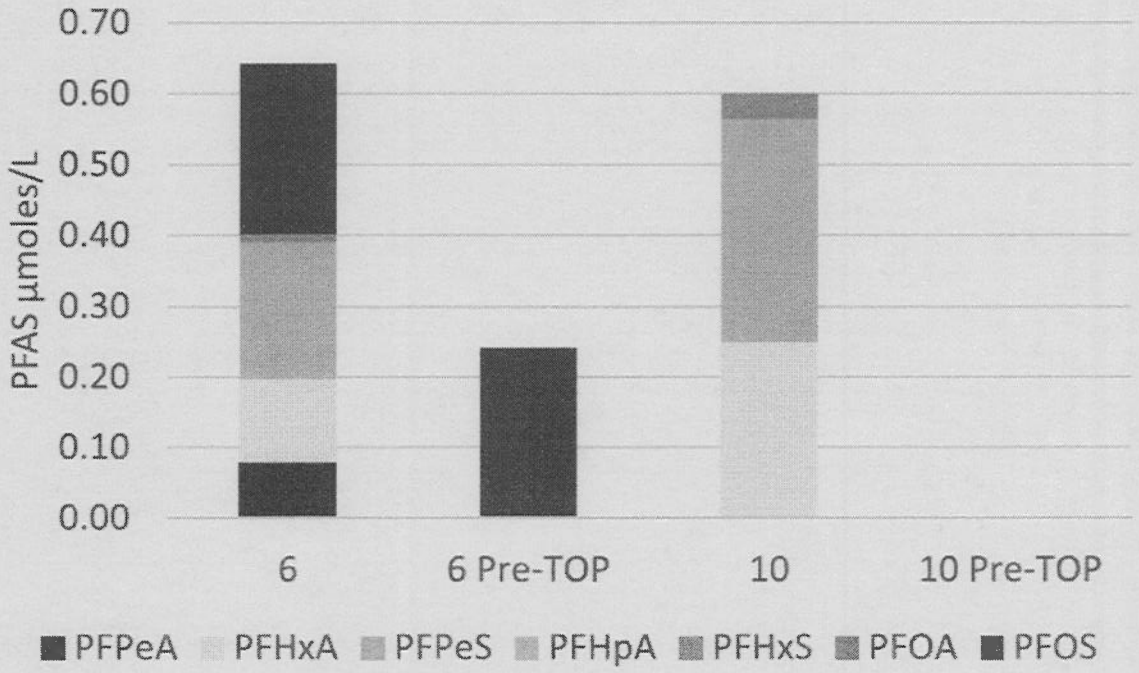
Perfluoroalkane sulfonic acids Long-chain: n ≥ 6 Short-chain: n < 6 Example short-chain representative: PFBS (n = 4)	
Perfluoroalkyl carboxylic acids Long-chain: n ≥ 7 Short-chain: n < 7 Example short-chain representatives: PFBA (n = 3), PFHxA (n = 5)	
Example of short-chain precursors 4:2 fluorotelomer alcohol (n = 4) 6:2 fluorotelomer alcohol (n = 6)	


EPA's Insecticide concentration findings vs Lasee et al.
25000000
20000000
15000000
10000000
5000000
0
PFAS Concentrations (ppt)
EPA
Lasee et al.

All PFAS ~ 30,000 different chemicals



TOP – "accelerated degradation"



We also found significant concentrations of PFAS in crops grown on the site

Table 3
Average tissue concentrations (ng PFAS/kg dry plant tissue or ppt) of PFAS from the targeted analysis of corn kernel, string bean pod, and peanuts. All samples are were collected from the commonly consumed tissue of these plants. Standard deviations are presented in parentheses.

	PFBA	PFHpA	PFHxA	PFHxS	PFOA	PFOS
CORN	1120	38	1020	4900	349	3230
	± 143	± 2.2	± 130	± 147	± 138	± 316
BEAN	3300	37	138	1150	176	4260
	± 48	± 0.8	± 76	± 104	± 72	± 154
PEANUT	580	313	0	200	162	407
	± 31	± 39		± 59	± 35	± 13
BLANK	0	0	0	0	0	0

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