

Investigating Uptake of PFOS in Vegetables on Farms in Maine

NEWMOA Webinar Series November 6, 2024

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Land application of biosolids and PFAS in soil



PFAS compounds are being identified in soils that were licensed for biosolids application.

- Plants are taking up PFAS into their plant parts.
- Understanding uptake will help farmers make better decisions.





Plant "Transfer Factor"



Agriculture Conservation & Forestry

How much is too much PFAS in soil?





Agriculture Conservation & Forestry

Collecting Co-Located Plant and Soil Samples to Determine Transfer Factors

Identify three 1'x1' areas for sample collection



Collect plant tissue from area and three soil cores



Remove biota from soil and homogenize (hand mix)





Co-Located Samples Collected in 2022 and 2023





Lab PFAS Analysis Methods

	Media Analyzed	Analysis Method	MS/MSD/Dups
Phia Pace	Soil	Modified 537.1 with Isotope Dilution	Matrix spikes, Lab Duplicates, Field Duplicates
BATTELLE	Plant Tissue (Cryogrind Homogenization)	DoD QSM 5.3 Table B-15	Matrix spikes Lab Duplicates
FDA U.S. FOOD & DRUG	Plant Tissue (sent homogenate from Battelle)	Method C-010.02	Matrix spikes Lab Duplicates









Co-Located Samples Collected in 2022 and 2023 from A Vegetable Farm







PFOS Transfer Factors for Vegetables





Source: Maine Department of Health and Human Services

Imputed PFOS Transfer Factors for Vegetables





Source: Maine Department of Health and Human Services



Poll Question

True or False

Research suggests that PFOS concentrations remain the same throughout different plant parts (roots, stems, leaves, etc.).

Different Uptake of PFOS by Vegetables

Little TFs < 0.001

Asparagus Bok Choy Corn (kernels) Green Beans Peppers Potatoes Rhubarb Broccoli

Some TFs 0.01-0.02

Arugula Carrots Kale Swiss Chard **More** TFs > 0.05

> Lettuce Spinach



Takeaways for Impacted Landowners and Other Stakeholders

- Certain crops are lower concern for uptake of PFOS than others
 - Asparagus, Rhubarb, Corn (grain), Potatoes

- Factors to help farmers manage on impacted ground
 - Crop Location
 - Crop Rotation



Takeaways for Impacted Landowners and Other Stakeholders

- There is year to year variability in uptake with certain crops
 - Contributing factors are an area to explore with research

 Larger and more sufficient datasets may help farmers manage their land and their crops to reduce or eliminate uptake.



Acknowledgements/Questions

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- The farmers, homesteaders, and landowners who provided their time and land for this important work.





Questions?



Additional Plant Uptake Research from Maine

AGRICULTURAL AND ENVIRONMENTAL CHEMISTRY | October 8, 2024

Uptake of Per- and Polyfluoroalkyl Substances in Mixed Forages on Biosolid-Amended Farm Fields

Thomas L. Simones*, Chris Evans, Caleb P. Goossen, Richard Kersbergen, Ellen B. Mallory, Susan Genualdi, Wendy Young, and Andrew E. Smith

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Supporting Information (1)

https://pubs.acs.org/doi/10.1021/acs.jafc.4c02078#

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REVIEW ARTICLE | JULY 06 2023

Linking drivers of plant per- and polyfluoroalkyl substance (PFAS) uptake to agricultural land management decisions **FREE**

Special Collection: Special Topic Collection: Per- and Polyfluoroalkyl Substances (PFAS) at the Interface of Biological and Environmental Systems

Alex E. Scearce ©; Caleb P. Goossen ©; Rachel E. Schattman ©; Ellen B. Mallory ©; Jean D. MacRae ©

https://pubs.aip.org/avs/bip/article/18/4/040801/2901178



Deriving Action Levels for Vegetables



Toxicity Value

Consumption Rate





= Action Level

Main Agriculture Conservation & Forestry

EPA MCLG and MLCs

Compound	Final MCLG	Final MCL (enforceable levels)
PFOA	Zero	4.0 parts per trillion (ppt) (also expressed as ng/L)
PFOS	Zero	4.0 ppt
PFHxS	10 ppt	10 ppt
PFNA	10 ppt	10 ppt
HFPO-DA (commonly known as GenX Chemicals)	10 ppt	10 ppt
	1 (unitless)	1 (unitless)
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	Hazard Index	Hazard Index

Source: EPA - https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas



Other PFAS Found in Vegetable Crops

- Short-Chain PFCAs identified in some vegetables where irrigation water and soil was impacted.
- Long-Chain PFSAs (PFOA, PFNA) in microgreens heavily irrigated with impacted water.

