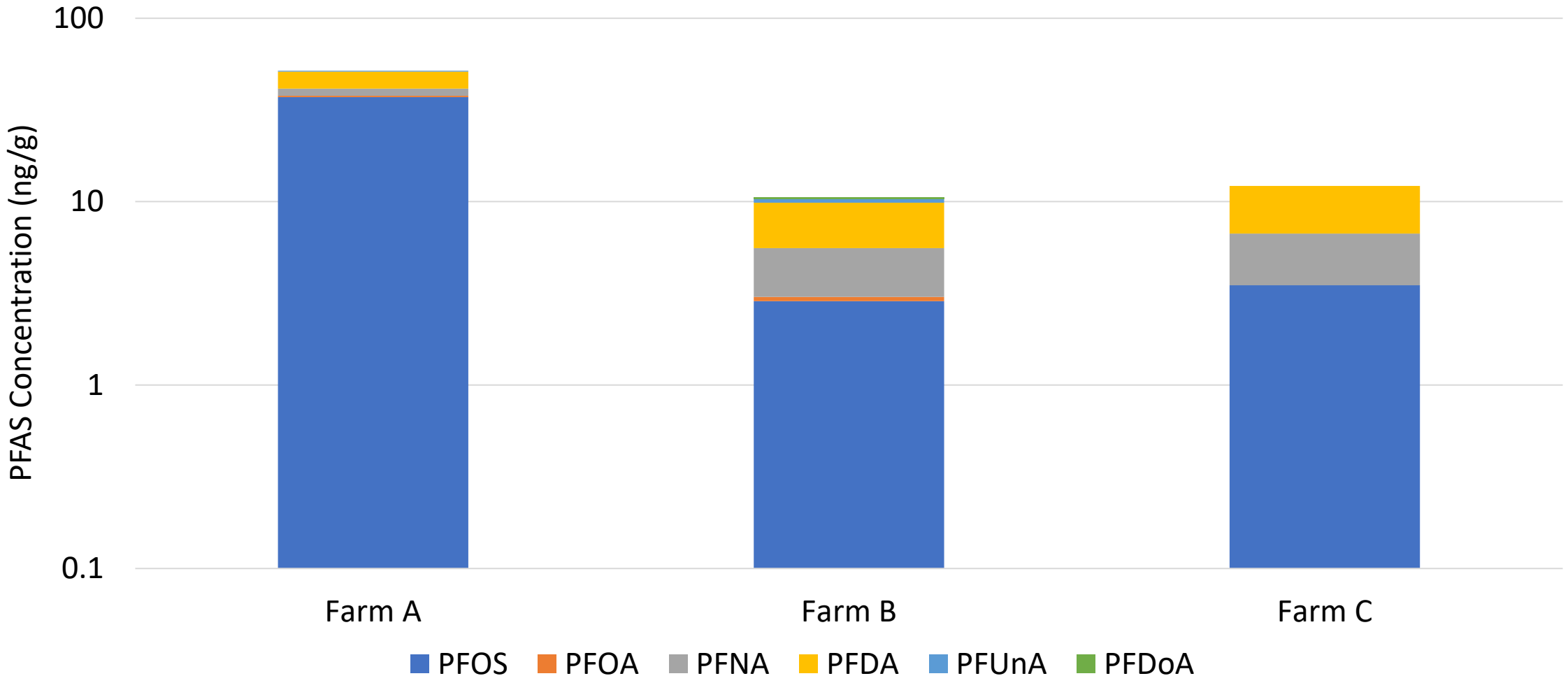
Summary findings of a multiyear study on PFAS uptake into grasses for livestock feed grown on biosolid amended farm fields

Thomas Simones, PhD
Assistant State Toxicologist
Maine Center for Disease Control and Prevention

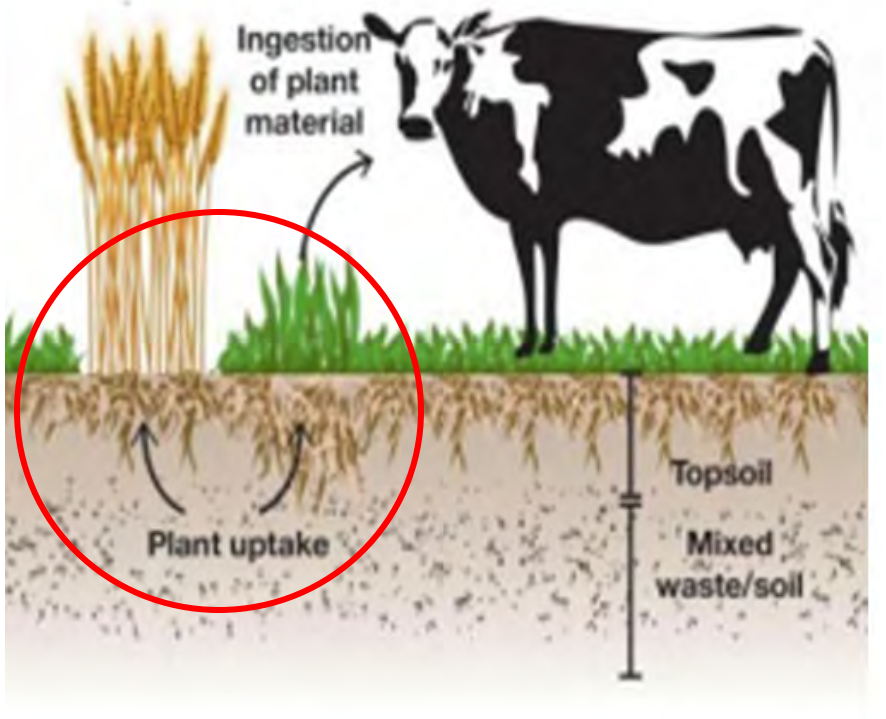
NEWMOA Northeast Conference on the Science of PFAS

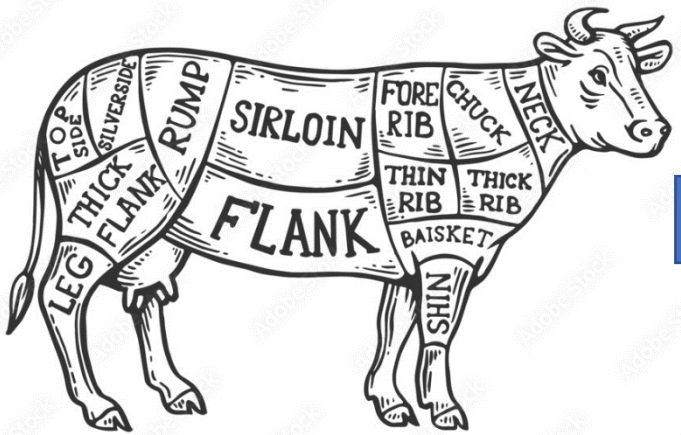
April 4, 2024

PFOS Contamination in Beef



Soil to Beef Exposure Pathway and PFOS Plant Uptake

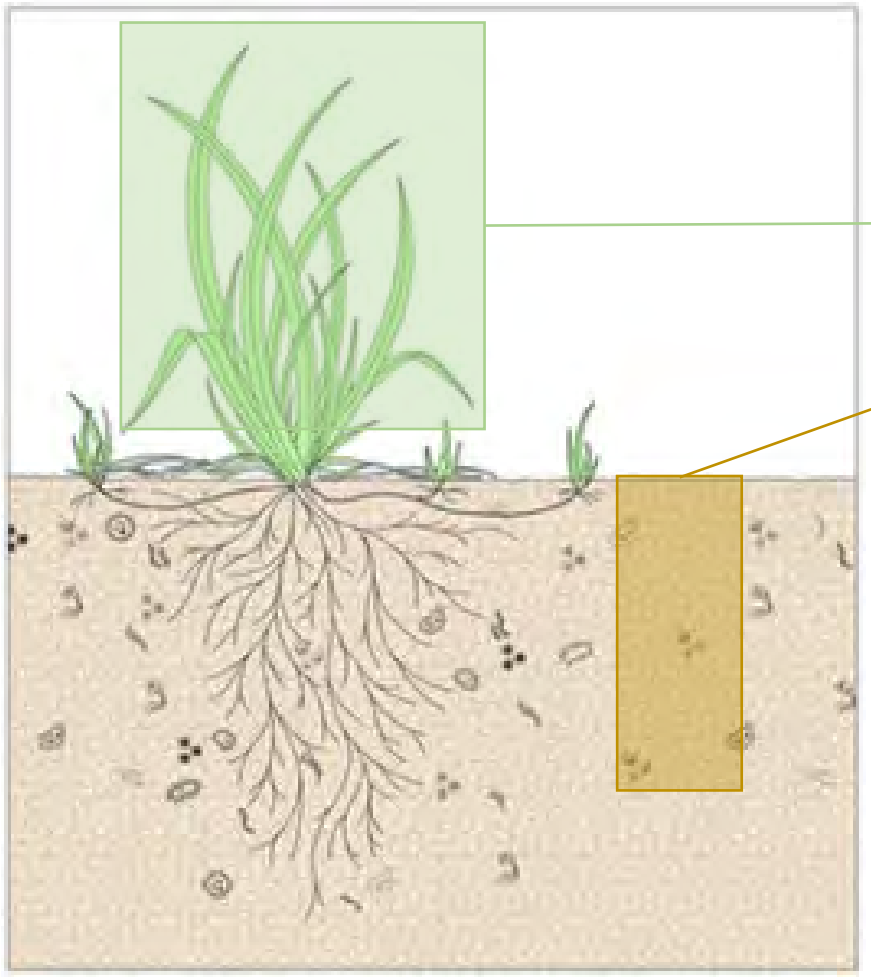






Soil → Hay/Corn → Cow → Beef → Child

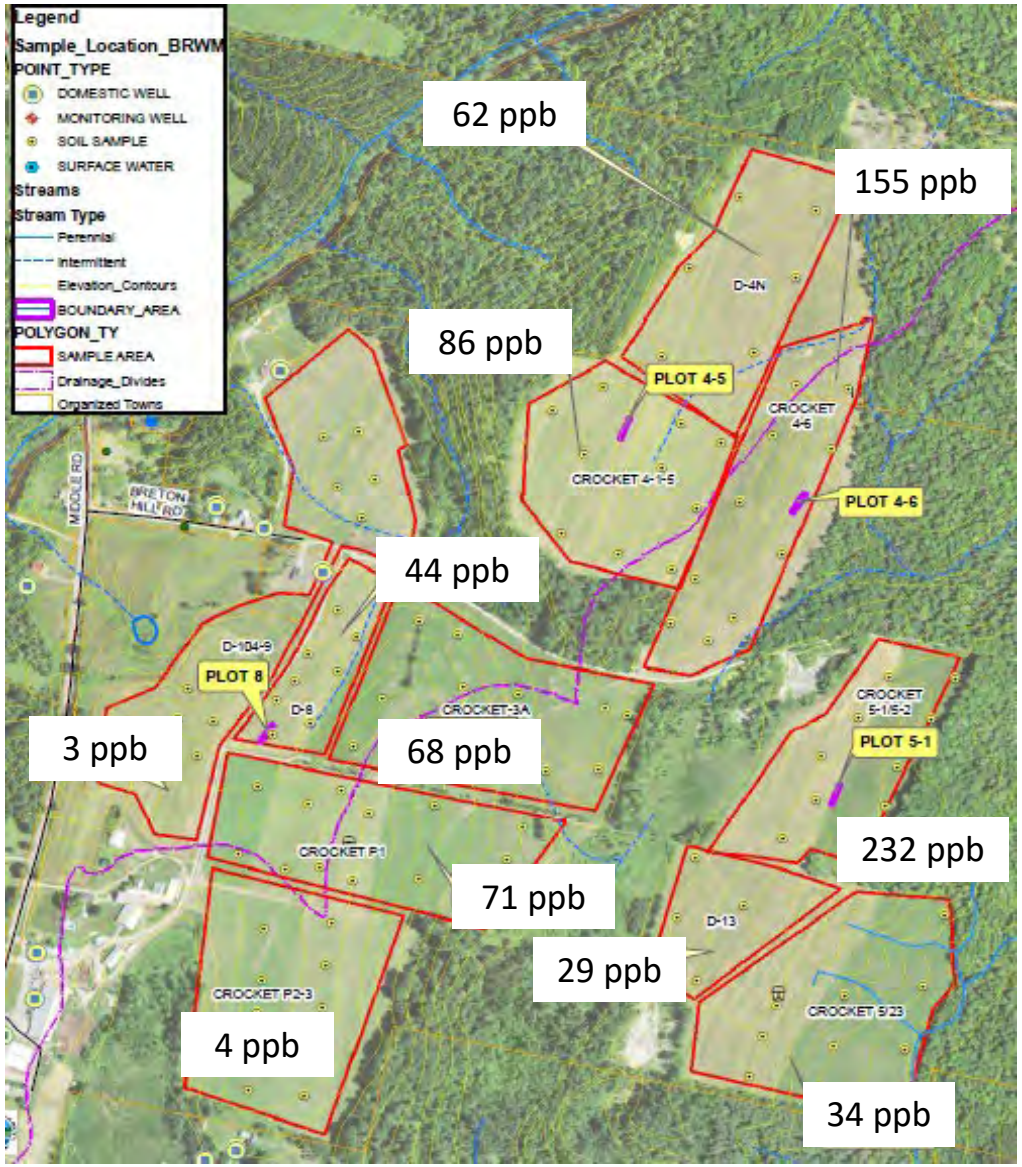
Plant Transfer Factor for Forage Crops



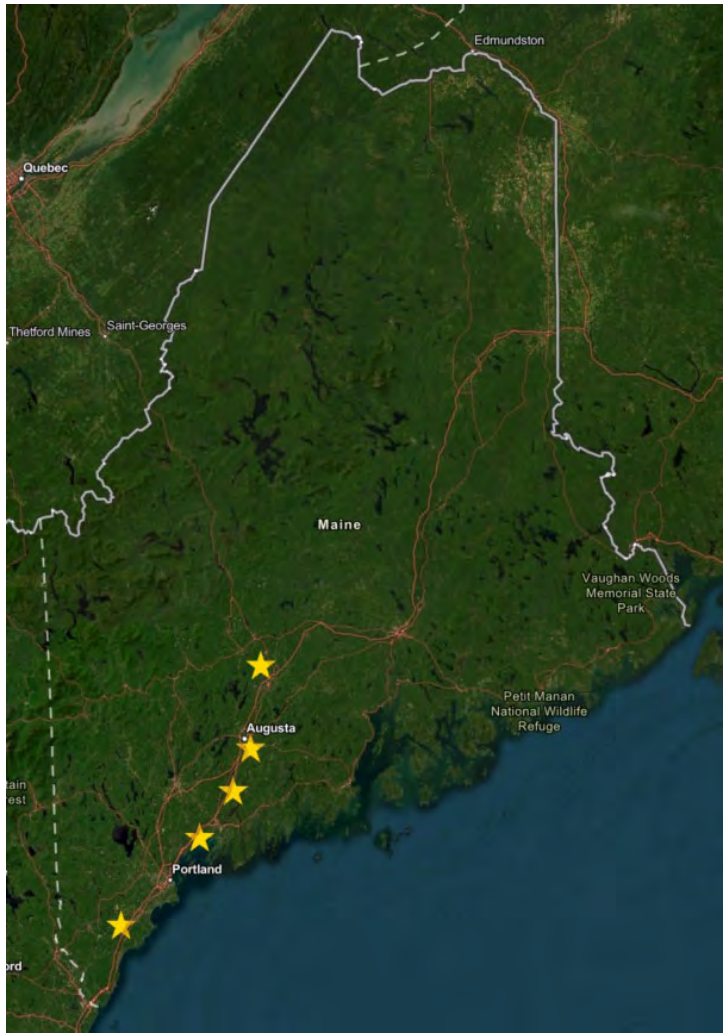
$$\frac{[Plant_{PFAS}\ dw]}{[Soil_{PFAS}\ dw]}$$

The Transfer Factor (TF) for forage crops is on a dry weight basis as forage intake for livestock is provided as dry weight.

Grass Field Plot and Farm Field Survey Studies







Co-located Grass/Soil Sample Collection Method







Laboratory PFAS Analysis Methods

Soils



- Lab developed isotope dilution method
- Matrix spikes and lab duplicates

Plants

BATTELLE

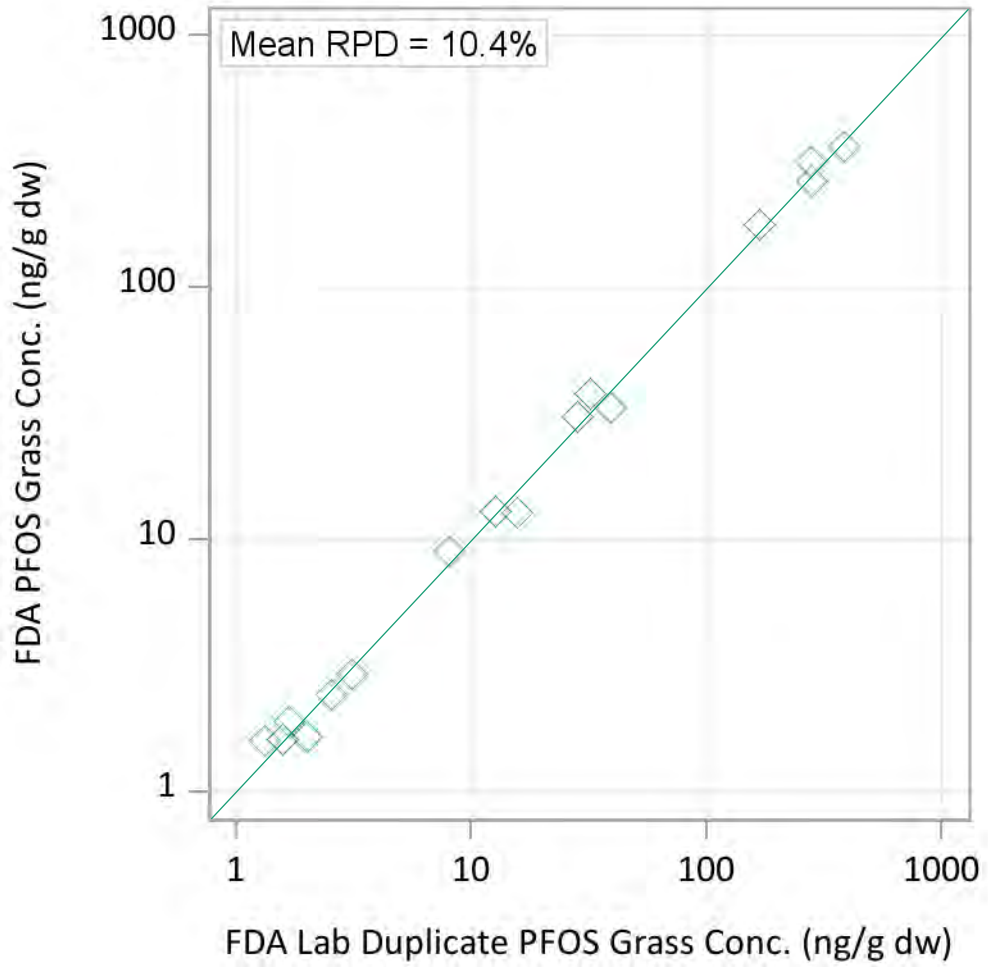
- Cryogrind homogenization
- DoD QSM 5.3 Table B-15 method
- Matrix spikes and lab duplicates

FDA

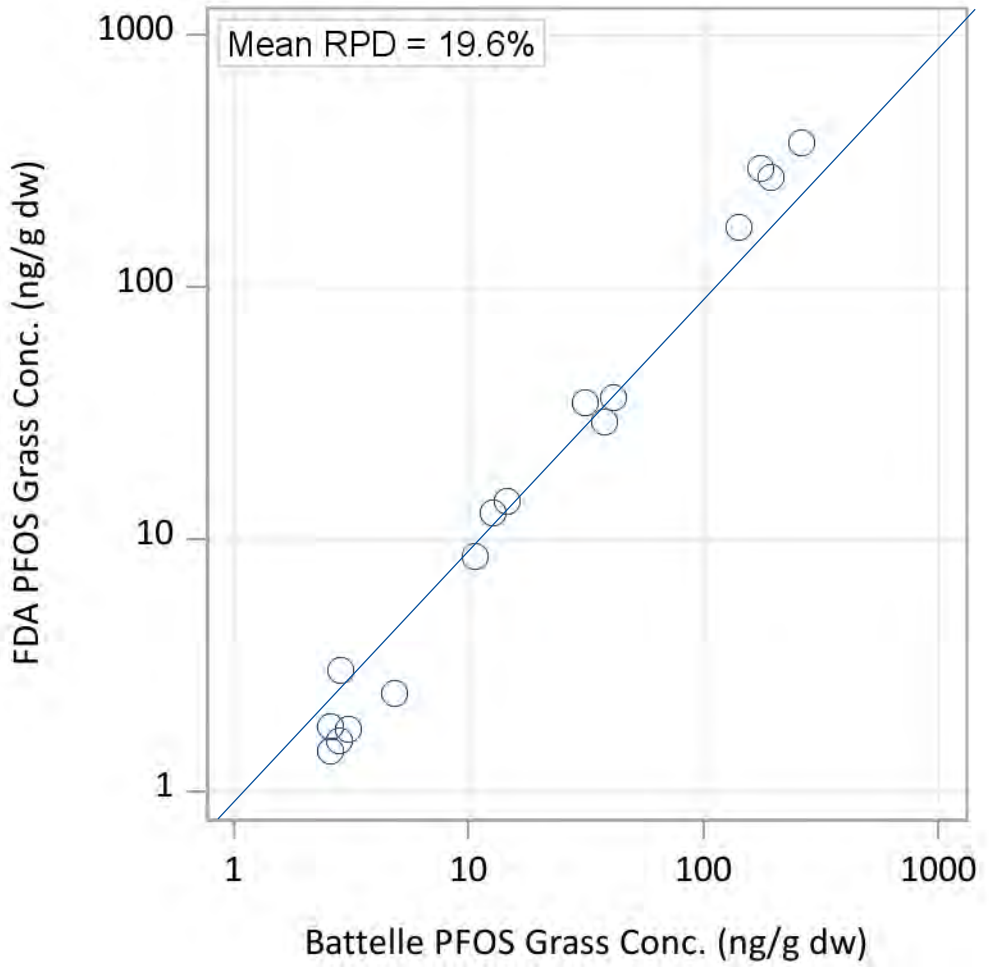
- TDS food isotope dilution method C-010.02
- Lab duplicates on all samples

PFOS in Plant Tissue Laboratory Comparisons

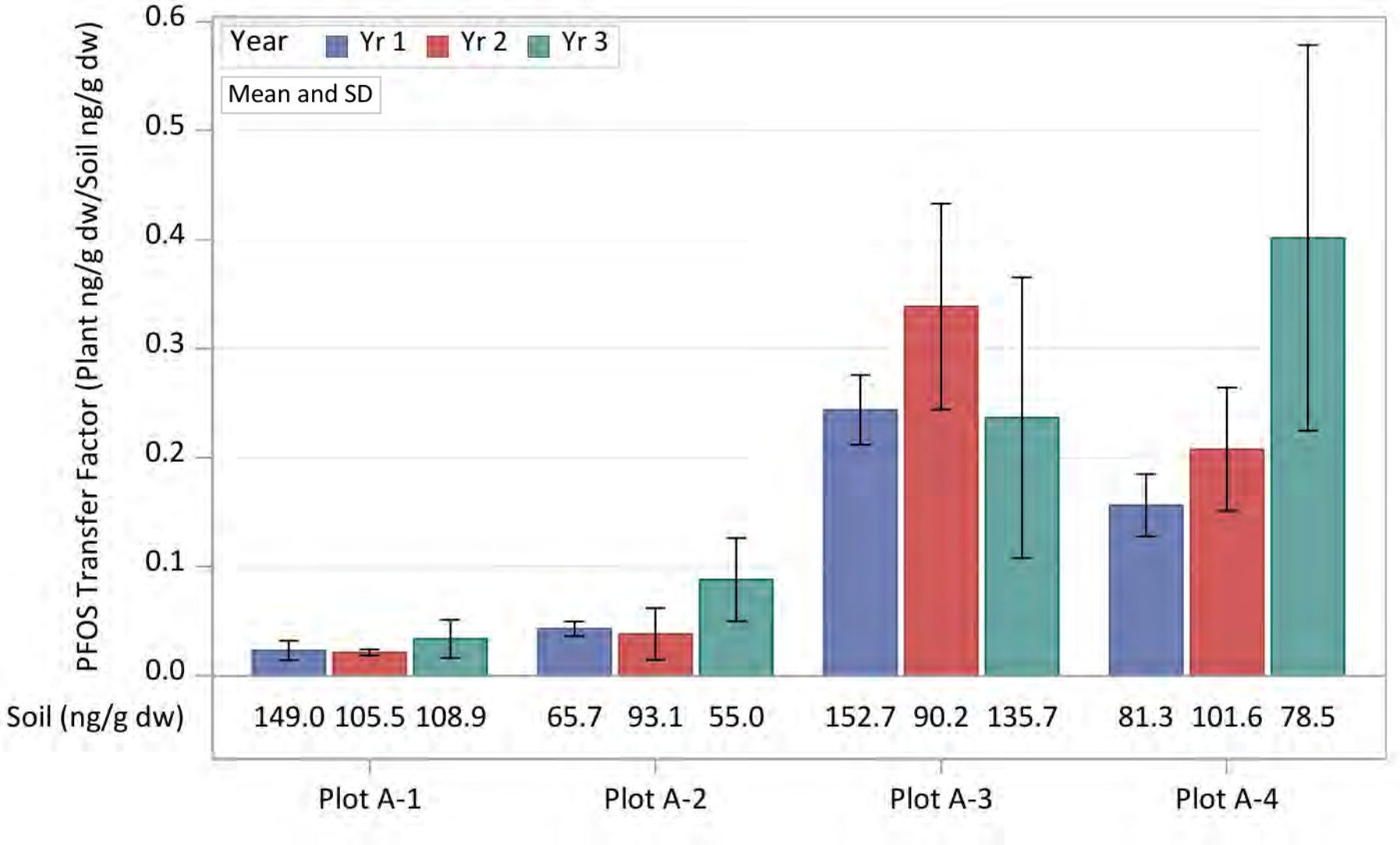
Laboratory duplicates



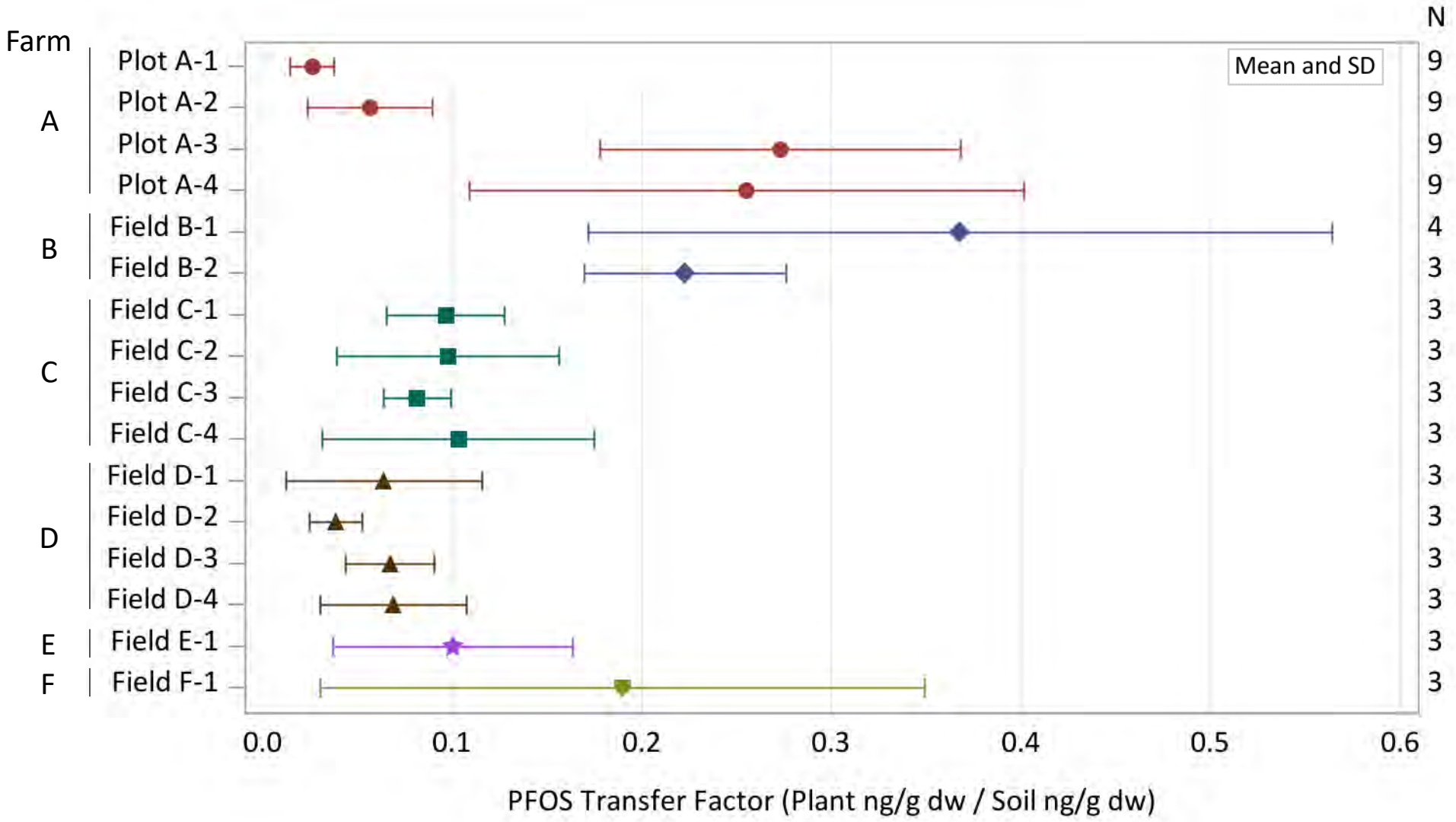
Interlaboratory results



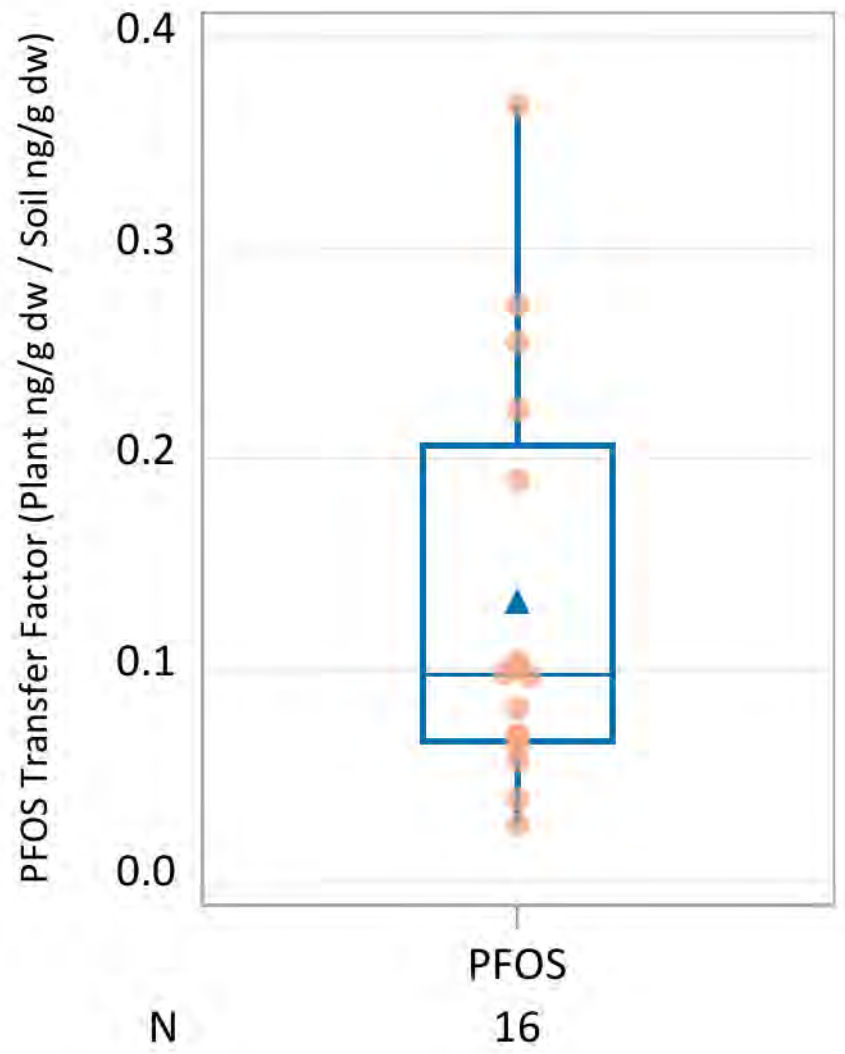
Field Plots Grass PFOS TFs Over 3 Years



Farm Field Survey Grass PFOS TFs



Average Grass PFOS TF Across Plots and Fields

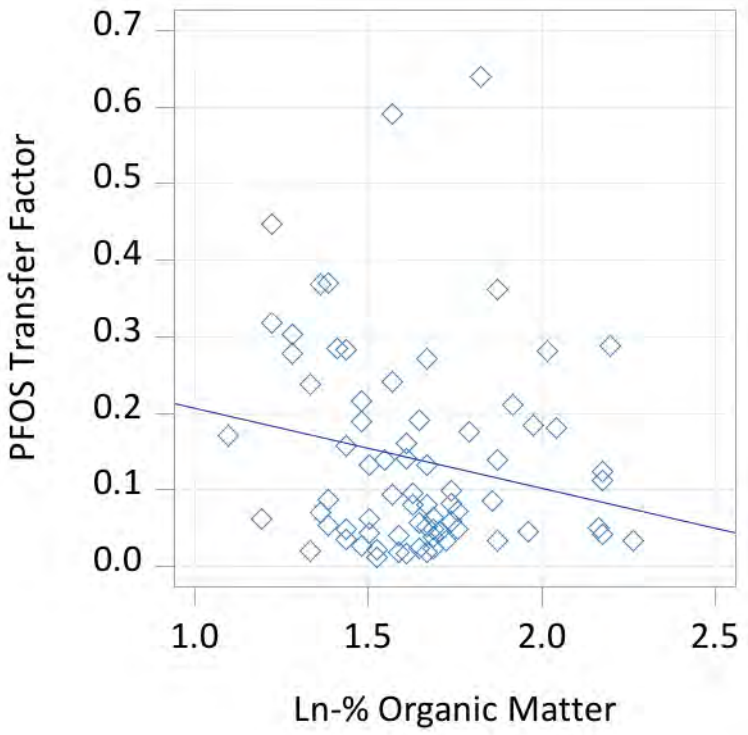


▲ Mean PFOS TF = 0.13 (SD 0.1)

● Field means PFOS TF range = 0.026 – 0.37

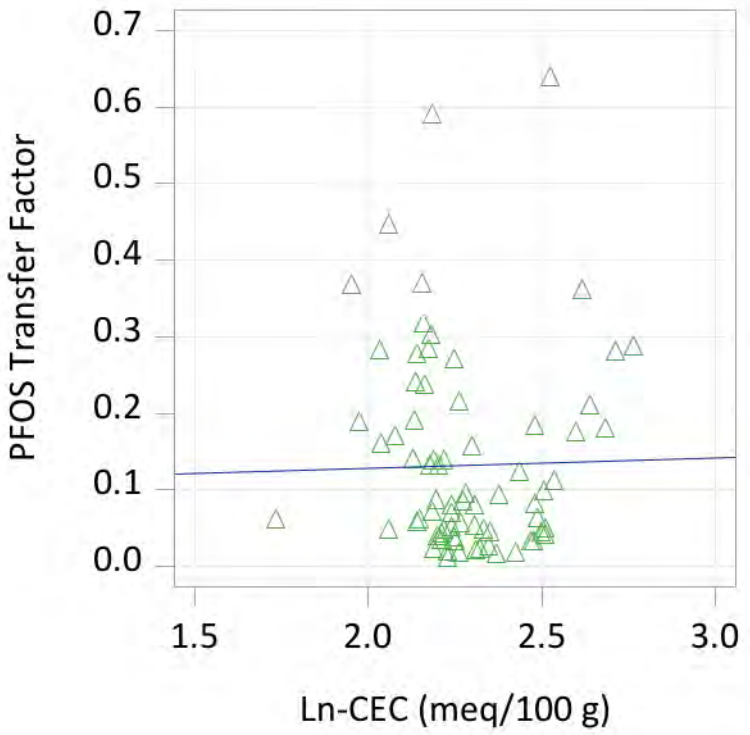
What might be influencing PFOS TF variability?

Percent Organic Matter



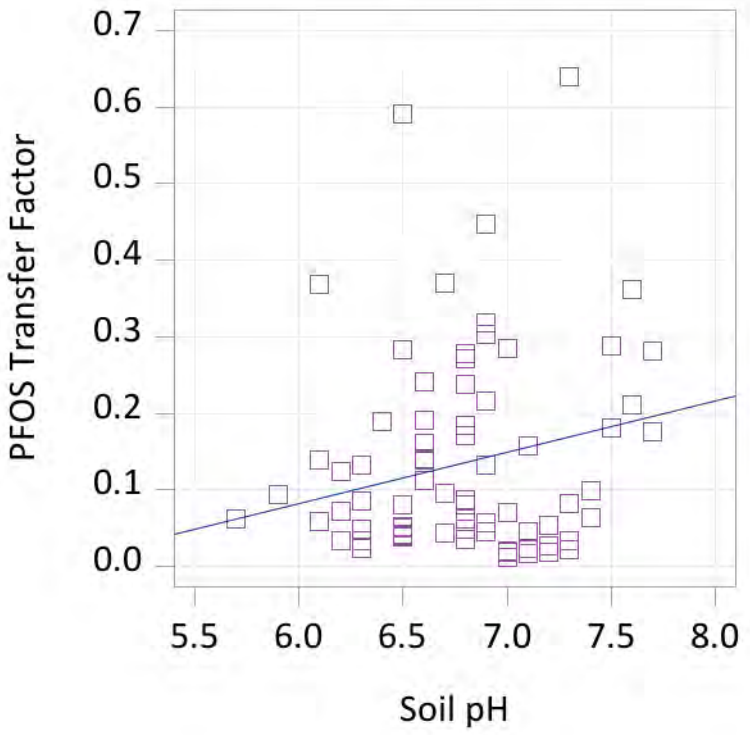
Estimate	Std error	p value
-0.104	0.065	0.12

Cation Exchange Capacity



Estimate	Std error	p value
0.014	0.097	0.89

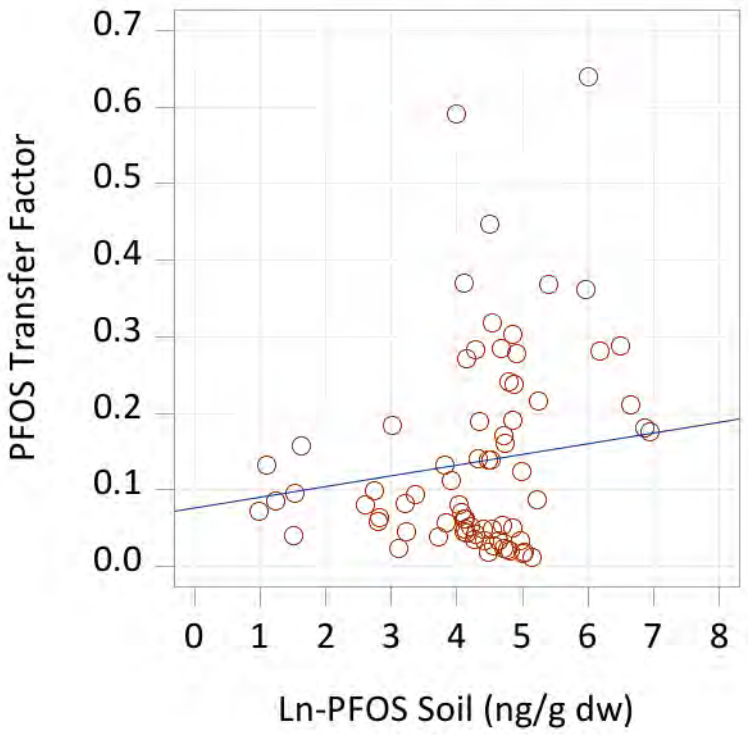
Soil pH



Estimate	Std error	p value
0.067	0.045	0.14

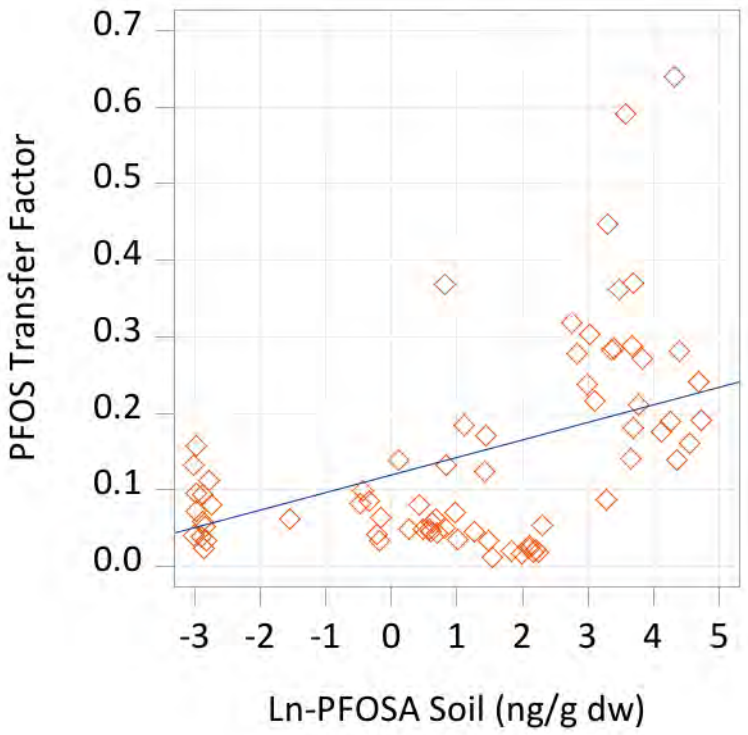
What might be influencing PFOS TF variability?

PFOS Soil Concentration



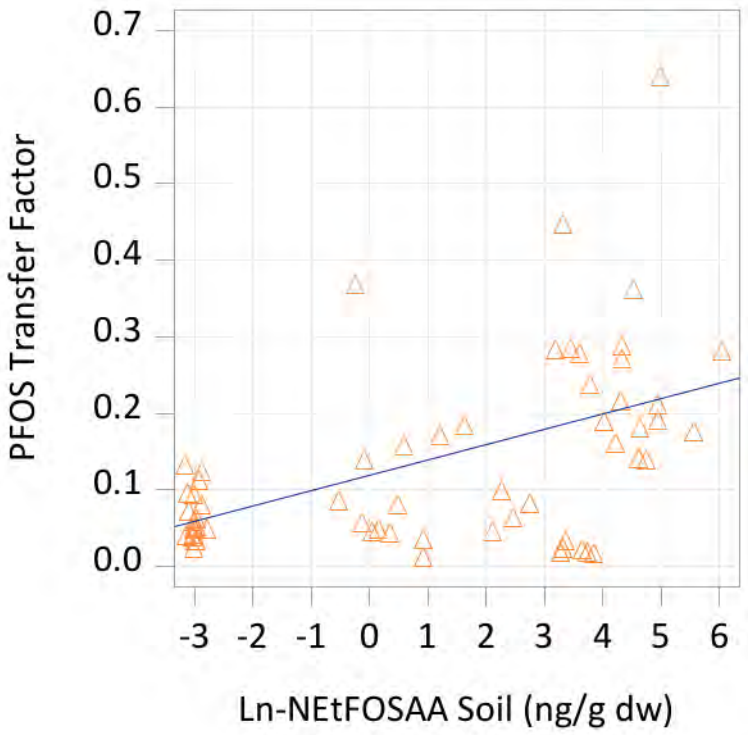
Estimate	Std error	p value
0.014	0.015	0.37

PFOSA Soil Concentration



Estimate	Std error	p value
0.023	0.007	0.002

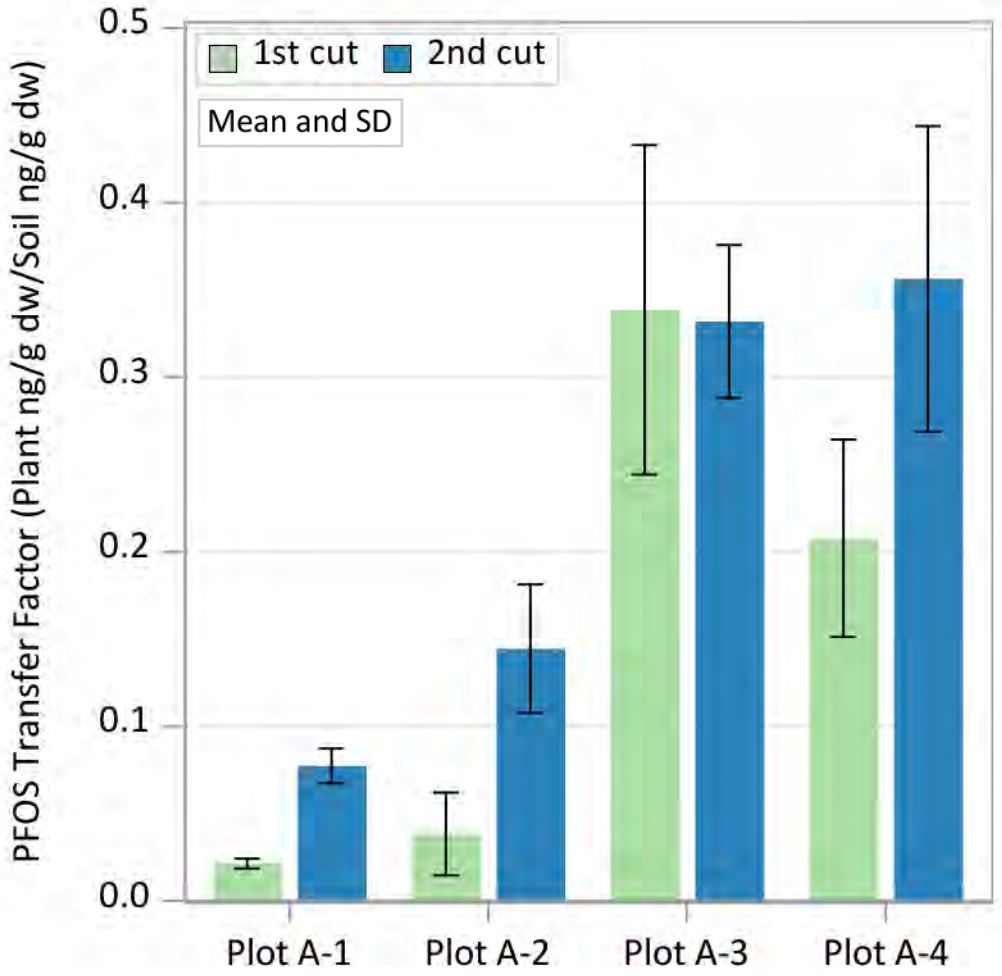
NEtFOSAA Soil Concentration



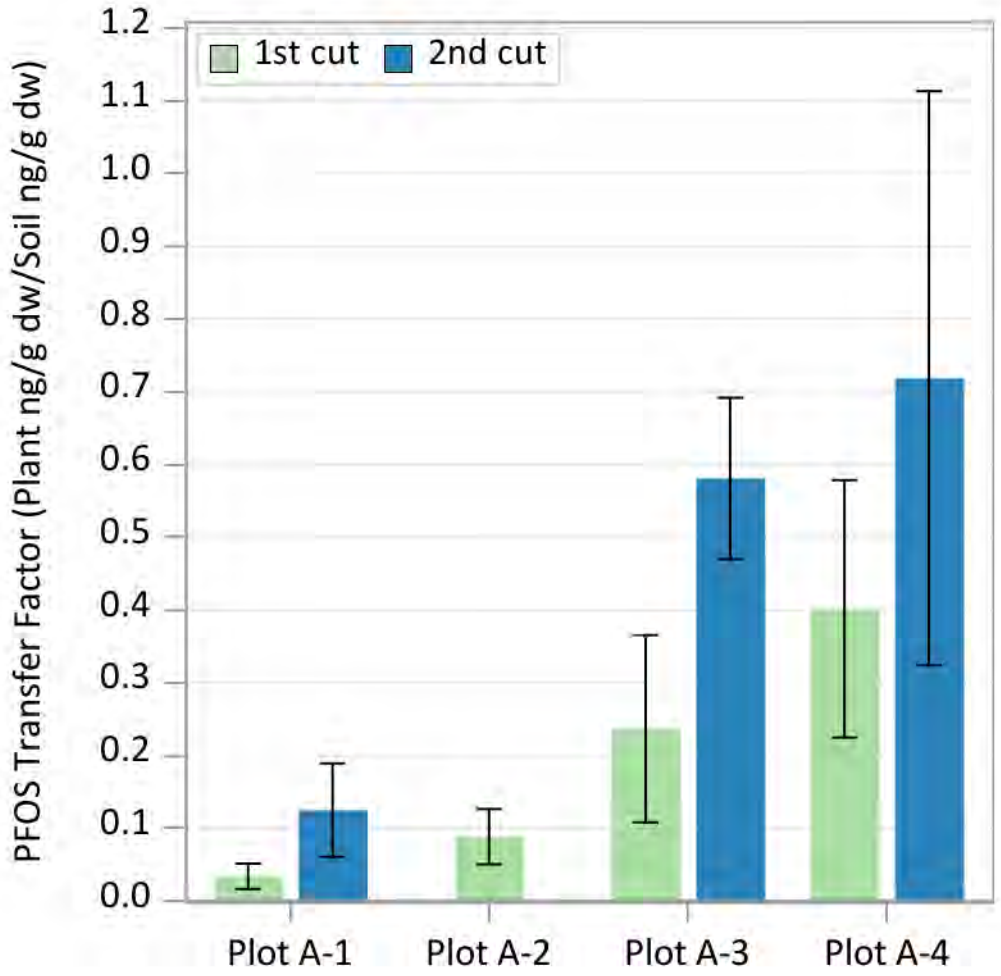
Estimate	Std error	p value
0.02	0.006	0.002

Field Plots 1st and 2nd Growth Cuttings

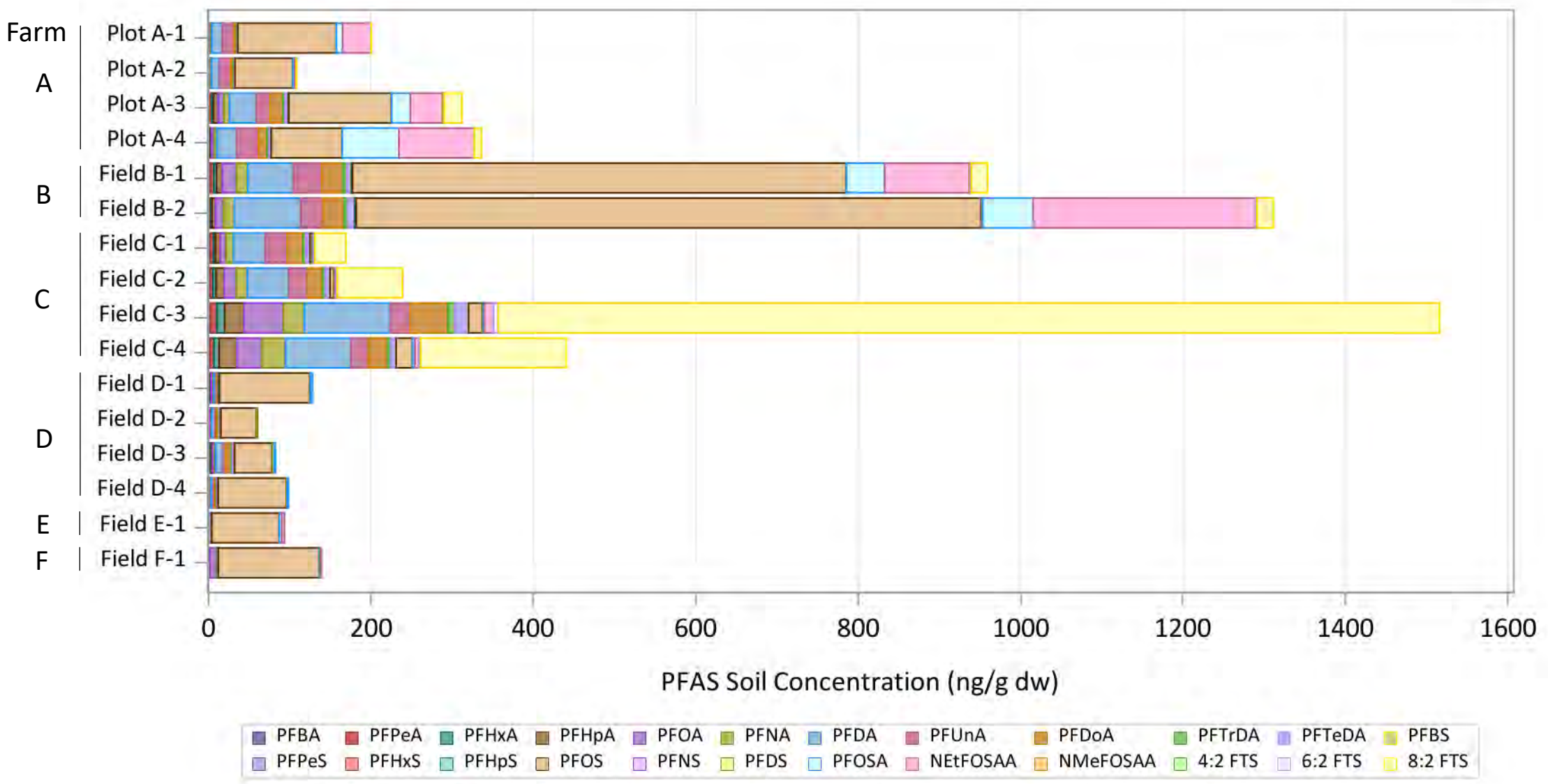
Year 2 Cuttings



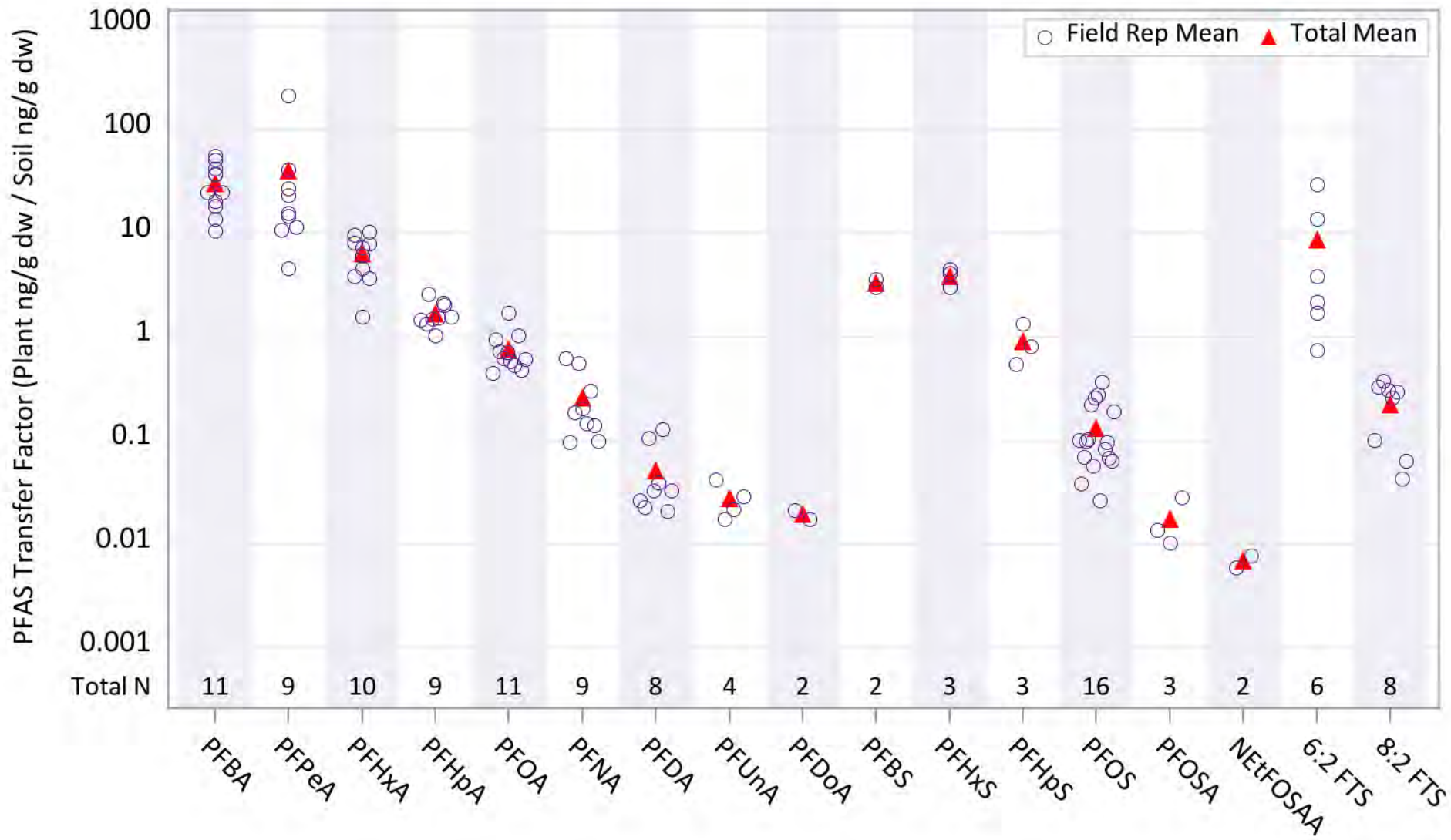
Year 3 Cuttings



PFAS Soil Profiles



Additional PFAS Grass Plant Transfer Factors



Conclusions

- Grass plant PFOS transfer factors can vary 10-fold between fields on the same farm sampled on the same day.
- PFOS transfer factors are variable among farms and fields sampled with average fieldwide values ranging from 0.026 to 0.37.
- The PFOS transfer factor is higher in soils with higher levels of PFOSA and NEtFOSAA.
- PFOS uptake appears to be higher in a second cutting of grass.
- Grass plant transfer factors for other PFAS vary by chain length.

Acknowledgements

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Association and the Broadreach Foundation



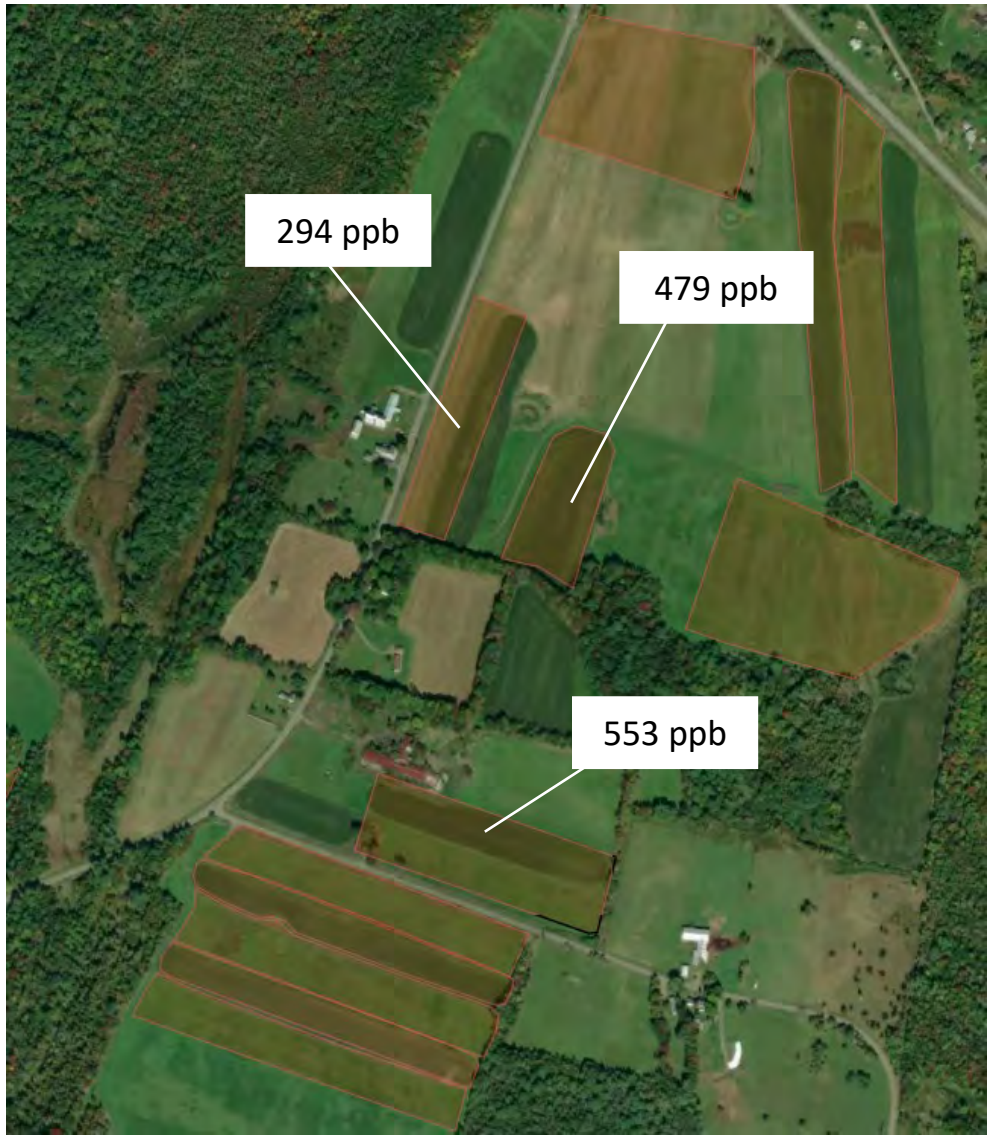
Maine
farmers

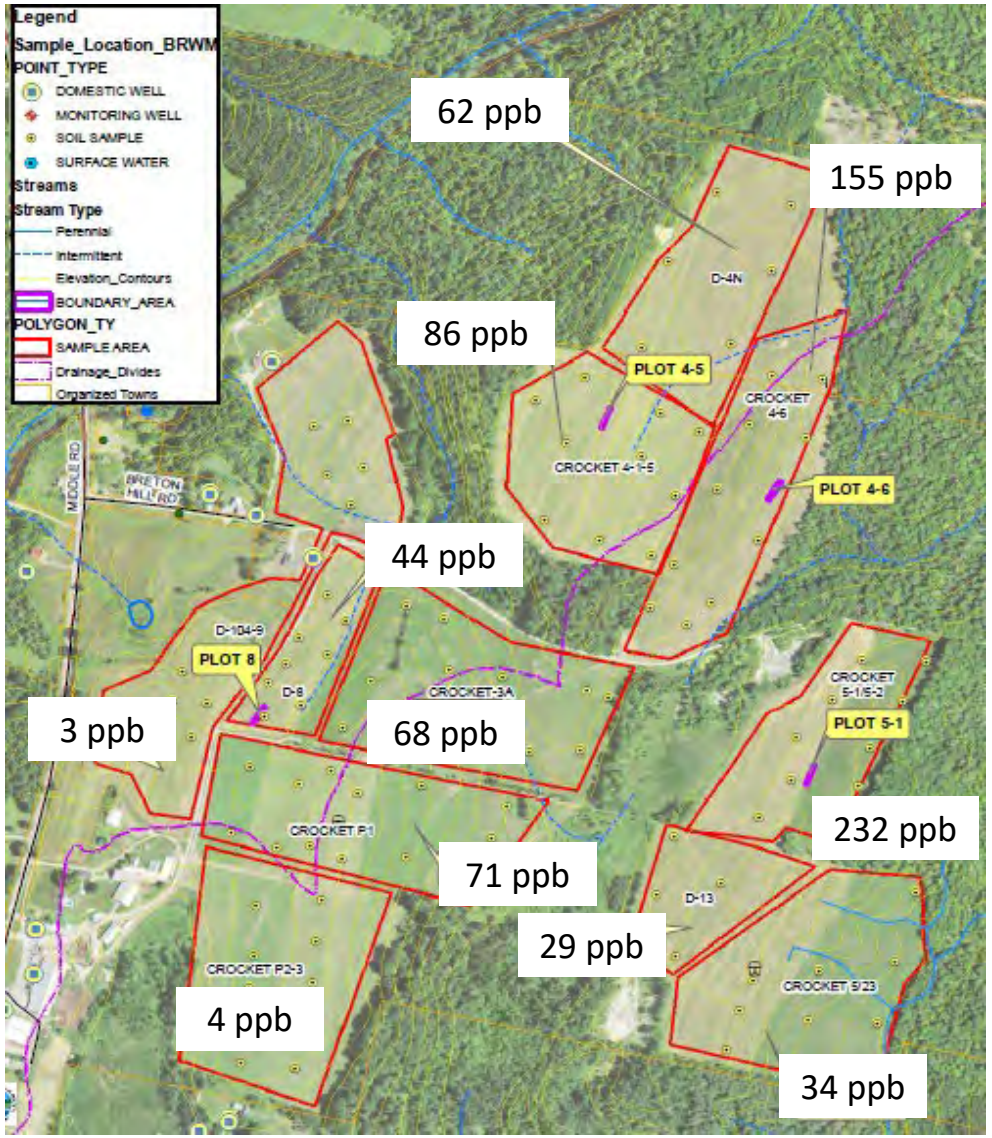
For more information

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Extra Slides

Corn Plant PFOS Uptake Study





Corn Plant PFOS Uptake Sampling Methods







PFOS Corn Plant Uptake Silgae vs Snaplage

